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TITLE: LIQUID CRYSTAL DISPLAY DEVICE

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ABSTRACT:

PROBLEM TO BE SOLVED: To provide a liquid crystal display device provided with an organic EL surface light emitting panel capable of obtaining white light having high intrasurface uniformity and executing highly efficient light emission and having color display performance.

SOLUTION: An organic EL element 15 for executing blue surface light emission is formed on the back of a transparent substrate 14 and a white light synthetic layer 16 consisting of a set of fine blue/red PL parts 16R, blue/green PL parts 16G and blue/blue PL parts 16B is arranged in the front of the substrate 14. Blue light is absorbed by the layer 16, light elements of R, G and B are emitted and these light elements constitute white light by additive color mixture, so that the white light can be supplied to a liquid crystal display panel 13 as illumination light. Thereby fine white display light based on uniform surface light emission can be made incident on the panel 13 and color display having high display performance can be attained.

* NOTICES *

1. This document has been translated by computer.So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

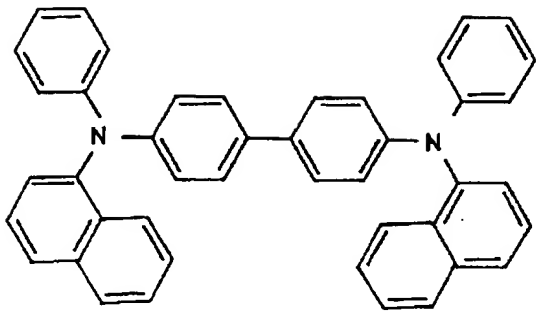
[Claim(s)]
[Claim 1] The liquid crystal display characterized by having arranged two or more photoluminescence meanses to absorb the wavelength region of the light generated in this organic EL element between the aforementioned liquid crystal display panel and the aforementioned organic EL element, and to generate the light of a wavelength region mutually different, respectively while having the organic EL element which performs field luminescence behind a liquid crystal display panel corresponding to the viewing area of the aforementioned liquid crystal display panel.
[Claim 2] The liquid crystal display according to claim 1 characterized by having a predetermined light filter corresponding to each pixel of the aforementioned liquid crystal display panel.
[Claim 3] The aforementioned photoluminescence means is a liquid crystal display according to claim 1 characterized by three kinds of a blue-red photoluminescence means to absorb a blue glow and to generate red light, the blue and the green photoluminescence means of absorbing a blue glow and generating green light, the blue and the blue photoluminescence means of absorbing a blue glow and generating a blue glow, and ** existing.

[Translation done.]

DETAILED DESCRIPTION

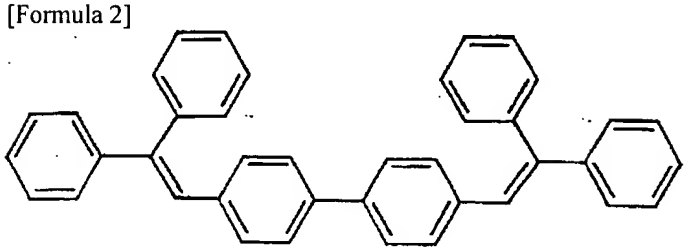
[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention relates to the liquid crystal display equipped with the electroluminescence devices which perform field luminescence as a back light in more detail about display.
[0002]
[Description of the Prior Art] As a conventional liquid crystal display, the thing of composition as shown, for example in drawing 9 is known. As shown in this drawing, this liquid crystal display 101 is equipped with the liquid crystal display panel 102 and the back light system 103. The liquid crystal display panel 102 has the front transparent substrate 104 and the back transparent substrate 105. The light filters 106R, 106G, and 106B of R, G, and B are formed in the back transparent substrate 105 of the front transparent substrate 104 and the field of the side which counters, i.e., an opposite medial surface, in the predetermined array. Moreover, the black mask 107 is formed between light filters 106R and 106G and 106B. Furthermore, these light filters 106R, 106G, and 106B and the black mask 107 are covered by the protective coat 108. Two or more front liquid crystal drive electrodes 109 which are formed in parallel, respectively and make the shape of a stripe are formed in the opposite medial surface of a protective coat 108, and the last orientation film 110 is formed in it so that these before liquid crystal drive electrode 109 and a protective coat 108 may be covered. On the other hand, two or more back liquid crystal drive electrodes 111 formed in the direction which intersects the above-mentioned front liquid crystal drive electrode 109 at parallel, respectively are arranged at the opposite medial surface of the back transparent substrate 105. In addition, the field where the front liquid crystal drive electrode 109 and the back liquid crystal drive electrode 111 cross is set up so that it may correspond with each above-mentioned light filters 106R, 106G, and 106B. Moreover, it is covered by the back orientation film 112 in the back transparent substrate 105 and the back liquid crystal drive electrode 111. And liquid crystal 113 is enclosed with the gap which the front transparent substrate 104 and the back transparent substrate 105 are stuck through the sealant which is not illustrated so that each orientation film 110 and 112 may counter, and is formed by both the orientation films 110 and 112 and the sealant. Furthermore, the front polarizing plate 114 is arranged at the opposite lateral surface (front face) of the front transparent substrate 104, and the back polarizing plate 115 is arranged at the opposite lateral surface (rear face) of the back transparent substrate 105. The back light system 103 is arranged behind such a liquid crystal display panel 102 of composition. This back light system 103 consists of the cold cathode tube 116, a light guide plate 117, a reflecting plate, a diffusion board, etc.
[0003] In the conventional liquid crystal display of such composition, the liquid crystal display of the light from the back light system 103 becomes possible by penetrating or being intercepted according to the state where the liquid crystal of the liquid crystal display panel 102 was modulated. Moreover, in each pixel portion, since outgoing radiation of the light by which the spectrum was carried out according to the operation of each light filter 106R, 106G, and 106B is carried out, color display becomes possible.
[0004]
[Problem(s) to be Solved by the Invention] However, it was difficult to obtain uniform field luminescence by the back light system 103 in the above-mentioned conventional liquid crystal display. This cause is because it is difficult to use light from this light source as the panel which performs efficient and uniform field luminescence using a waveguide operation of a light guide plate 117, the reflex action of a reflecting plate, a dispersion operation of a diffusion board, etc. since the cold cathode tubes 116 which are the light source of the back light system 103 are a straight-line-like thing and a U character-like thing.
[0005] Examination which uses for a back light system inorganic EL (electroluminescence) panel which is a field luminescence panel (distributed type) as a policy to the trouble of such a back light system is performed. However, sufficient brightness is not obtained but, moreover, an inorganic EL panel has the trouble that a luminescence life is short. Especially, in an inorganic EL panel, there is a trouble of [though white luminescence is hard to be obtained and it is obtained] a low in luminous efficiency. For this reason, it is thought that it is difficult to use an inorganic EL panel practical as a back light.
[0006] Moreover, use of the organic EL panel which emits light in high brightness with small applied voltage compared with an inorganic EL element as a field luminescence panel is also considered by recently. However, even if it uses an organic EL panel, also theoretically, it is thought that it is difficult to realize the white light currently demanded as a back light of a color display by high luminous efficiency on element level. That is, if the organic luminous layer in an organic EL panel tends to be made to distribute a fluorochrome etc. and it is going to acquire the white light, it will become difficult to generate the white

light efficiently by thermal loss by the energy changes between the molecules which approached, or gradual deactivation.
[0007] The homogeneity within a field of white luminescence is equipped with the back light system which performs efficient luminescence high moreover, and the technical problem of 1 which this invention tends to solve has it in the point what means should be provided for obtaining the liquid crystal display which can perform good color display. Moreover, other technical problems which this invention tends to solve are in the point what means should be provided, in order to obtain the liquid crystal display which color display of high luminous efficiency can be made [liquid crystal display] possible, and can decrease power consumption.
[0008]
[Means for Solving the Problem] In the liquid crystal display, invention according to claim 1 is characterized by having arranged two or more photoluminescence meanses to absorb the wavelength region of the light generated in this organic EL element between the aforementioned liquid crystal display panel and the aforementioned organic EL element, and to generate the light of a wavelength region mutually different, respectively while it is equipped with the organic EL element which performs field luminescence behind a liquid crystal display panel corresponding to the viewing area of the aforementioned liquid crystal display panel.
[0009] In invention according to claim 1, the light generated in the organic EL element is absorbed with a photoluminescence means, and the light of a characteristic wavelength region is generated with each photoluminescence means. Incidence of the light generated with the photoluminescence means of these plurality is carried out to a liquid crystal display panel, and it turns into light for a display. By considering as such composition, the light of the same color occurs uniformly in the field of an organic EL element, and in order to generate the light of the wavelength region where the photoluminescence meanses which absorbed this light differ, respectively, it becomes possible to perform color display by the side of a liquid crystal display panel. Moreover, by using a photoluminescence means, it becomes possible to perform good luminescence of energy efficiency using the light generated in the organic EL element, and a liquid crystal display with high display brightness is made possible.
[0010]
[Embodiments of the Invention] It explains based on each operation form which shows the detail of the liquid crystal display concerning this invention hereafter to a drawing.
(Operation form 1) Drawing 1 is the cross section showing the operation form 1 of the liquid crystal display concerning this invention. 11 are a liquid crystal display among drawing. This liquid crystal display 11 consists of an organic EL side luminescence panel 12 and a liquid crystal display panel 13, as shown in this drawing.
[0011] First, the composition of organic EL side luminescence panel 12 is explained. The field behind the transparent EL substrate 14 which becomes by glass or synthetic resin as organic EL side luminescence panel 12 is shown in drawing 1 (lower part in drawing) Organic EL element 15 which has a luminescence field corresponding to a side with the viewing area of the liquid crystal display panel 13 is formed. (It is hereafter called a rear face) It is formed so that the white photosynthesis layer 16 as a photoluminescence (henceforth PL) array may correspond to the field (henceforth front face) side ahead of the transparent EL substrate 14 (upper part in drawing) with the luminescence field of organic EL element 15.
[0012] One by one, the laminating of the anode electrode 17, the organic EL layer 18, and the cathode electrode 19 is carried out, and organic EL element 15 becomes the rear face of the transparent EL substrate 14, as shown in this drawing. For example, it is transparent, it is ITO (indium tin oxide), and the anode electrode 17 is formed so that it may correspond with the viewing area of the liquid crystal display panel 13. The organic EL layer 18 is N and N'-JI (alpha-naphthyl) to the order from the anode electrode 17 side. - N and N'-diphenyl -1, the 1'-biphenyl -4, and the electron hole transporting bed that consists of a 4'-diamine (henceforth alpha-NPD), A 4 and 4'-screw (2 and 2'-diphenyl vinylene) biphenyl The luminous layer which 96wt(s)% and a 4 and 4'-screw (2-carbazole vinylene) biphenyl (henceforth BCzVBi) become [(it is hereafter called DPVBi)] from 4wt(s)%, The laminating of the electronic transporting bed and ** which consist of a tris (8-hydroxyquinoline) aluminum complex (henceforth Alq3) is carried out, and they are constituted. ** [impression of electric field / generate / a blue glow / the organic EL layer 18 formed of such a material layer] The luminescence field of this organic EL layer 18 is set up so that it may correspond with the viewing area of the liquid crystal display panel 13. Below, alpha-NPD, DPVBi, BCzVBi, and the structure expression of Alq3 are shown.
[0013]
[Formula 1]



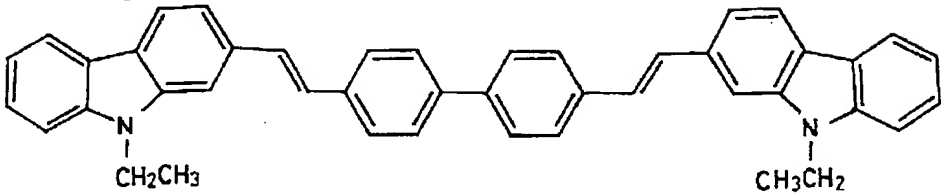
α-NPD

[Formula 2]



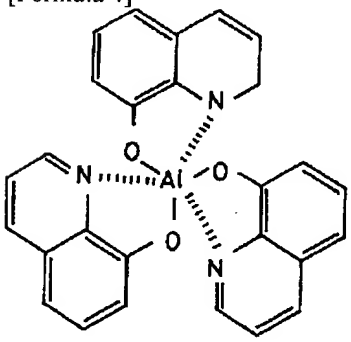
DPVBi

[Formula 3]



BCzVBi

[Formula 4]



Alq3

[0014] And the cathode electrode 19 formed in the rear face of the organic EL layer 18 is formed by metal material with the property to be easy to pour in a carrier to the organic EL layer 18, for example, MgIn, AlLi, etc. This cathode electrode 19 is also formed so that it may correspond with the viewing area of the liquid crystal display panel 13. In addition, although illustration is not carried out, the protective coat covered from water and oxygen all over organic EL-element 15 is formed.
[0015] Next, the composition of the white photosynthesis layer 16 formed in the front-face side of the transparent EL

substrate 14 is explained. Blue-red PL section 16R which this white photosynthesis layer 16 absorbs the light of a blue wavelength region, and newly generates the light of a red wavelength region, The blue and green PL section 16G which absorb the light of a blue wavelength region and newly generate the light of a green wavelength region, The blue and blue PL section 16B which absorbs the light of a blue wavelength region and generates the light of a blue wavelength color, it adjoins mutually in the array of ****** -- as -- arranging -- the occupancy area of each PL section -- an area of 1 pixel of a liquid crystal display panel -- comparing -- enough -- being detailed (desirable -- 1/3 or less area of 1-pixel area) -- it is set up so that it may become In addition, as a material which constitutes these PL section, a well-known photoluminescence material is applicable.

[0016] In the above, although the composition of organic EL side luminescence panel 12 was explained, the liquid crystal display panel 13 is explained below. In addition, with this operation form, the thing of composition of using a simple matrix drive method as a liquid crystal display panel 13 is applied.

[0017] Hereafter, the concrete composition of the liquid crystal display panel 13 of this operation form is explained. The liquid crystal display panel 13 of this operation form has the front transparent substrate 20 and the back transparent substrate 21. The light filters 22R, 22G, and 22B of R, G, and B are formed in the opposite inside side of the front transparent substrate 20 in the predetermined array. Moreover, the black mask 23 is formed between light filters 22R and 22G and 22B. Furthermore, these light filters 22R, 22G, and 22B and the black mask 23 are covered by the protective coat 24. Two or more front liquid crystal drive electrodes 25 which are formed in parallel, respectively and make the shape of a stripe are formed in the opposite inside side of a protective coat 24, and the last orientation film 26 is formed in it so that these before liquid crystal drive electrode 25 may be covered. On the other hand, two or more back liquid crystal drive electrodes 27 formed in the direction which intersects the above-mentioned front liquid crystal drive electrode 25 at parallel, respectively are arranged in the opposite inside side of the back transparent substrate 21. In addition, the field (pixel field) where the front liquid crystal drive electrode 25 and the back liquid crystal drive electrode 27 cross is set up so that it may correspond with each above-mentioned light filters 22R, 22G, and 22B. Moreover, it is covered by the back orientation film 28 in the back transparent substrate 21 and the back liquid crystal drive electrode 27. And liquid crystal 29 is enclosed with the gap which the front transparent substrate 20 and the back transparent substrate 21 are stuck through the sealant which is not illustrated so that each orientation film 26 and 28 may counter, and is formed by both the orientation films 26 and 28 and the sealant. Furthermore, the front polarizing plate 30 is arranged in the opposite outside side (front face) of the front transparent substrate 20, and the back polarizing plate 31 is arranged in the opposite outside side (rear face) of the back transparent substrate 21.

[0018] Next, an operation and operation of the liquid crystal display 11 of such composition are explained. When displaying by the liquid crystal display panel 13, by carrying out the line sequential drive of the front liquid crystal drive electrode 25 and the back liquid crystal drive electrode 27, electric field are impressed to liquid crystal 29, and it drives so that liquid crystal 29 may become predetermined orientation according to the intensity of electric field. By the light by which outgoing radiation was carried out from organic EL side luminescence panel 12 according to the orientation state of this liquid crystal 29 penetrating the pixel section, or being intercepted, a display becomes possible. the light which penetrated each light filter since each pixel section of the liquid crystal display panel 13 was equipped with light filters 22R, 22G, and 22B, respectively at this time -- the spectrum of a light filter -- outgoing radiation of the light of the color of R, G, and B is carried out by operation, respectively

[0019] By the way, with this operation gestalt, if electric field are impressed between the anode electrode 17 and the cathode electrode 19 in organic EL element 15, a blue glow will occur from the organic EL layer 18. Since the cathode electrode 19 is the metal material of light reflex nature, this blue glow penetrates the transparent EL substrate 14, and it carries out incidence to the white photosynthesis layer 16. At this time, in the white photosynthesis layer 16, it is blue-red PL section 16R, and the light of the blue wavelength region from organic EL element 15 is absorbed, and the light of a red wavelength region is newly generated. Moreover, in blue and green PL section 16G, the light of a blue wavelength region is absorbed and the light of a green wavelength region is newly generated. Furthermore, in blue and blue PL section 16B, the light of a blue wavelength region is absorbed and the light of a wavelength color with more blue long wavelength is generated. Moreover, as described above, since these PL sections 16R, 16G, and 16B are arranged, respectively so that it may become detailed enough as compared with an area of 1 pixel of a liquid crystal display panel, and it may be set up and may adjoin mutually in a predetermined array, to each PL section front, a detailed beam light of R, G, and B generates them. Since the beam light of these large number is diffused in radiation, it turns into the white light by additive mixture of colors. And in each pixel section of the above-mentioned liquid crystal display panel 13, this white light is penetrated or intercepted according to the orientation state of liquid crystal 29. When the white light penetrates the pixel section, a spectrum is carried out by the light filter and a desired color specification light can be obtained. By such operation, color display becomes possible with the liquid crystal display 11 of this operation gestalt.

[0020] Although it is generally so efficient that photoluminescence material has the near wavelength region of absorption light which serves as excitation energy to the wavelength region of excitation light, especially with this operation gestalt Since it has the operation which the blue glow which is the light by the side of a short wavelength region most among the lights is absorbed [operation], and generates the light of the predetermined wavelength region of a long wavelength region more in each PL section which constitutes the white photosynthesis layer 16, since the photoluminescence efficiency of the light is very high, Energy loss can be suppressed low. For this reason, luminescence from organic EL element 15 can be used effectively for the maximum. Moreover, in organic EL side luminescence panel 12, homogeneity within a field of white

luminescence can be made high by operation of the white photosynthesis layer 16. Furthermore, organic EL side luminescence panel 12 is the composition equipped with organic EL element 15 which generates the high blue glow of luminous efficiency from the first, since an efficient new light can be generated in the white photosynthesis layer 16 by making this blue glow into the origin, can make the brightness of display light high and can perform the good display of contrast. Moreover, with this operation gestalt, in order to use organic EL element 15 which performs field luminescence, it has the advantage that-izing of the back light system can be carried out [thin shape]. Since organic EL element 15 is a low-battery direct-current drive, it has the advantage that adjustable [of brightness / continuous] is easy as compared with an element like a cold cathode tube or an inorganic EL element which carries out a high-voltage alternating current drive, and desired brightness can be set up according to specification environment further again.

[0021] (Operation gestalt 2) The cross section and drawing 2 which show the operation gestalt 2 of the liquid crystal display which drawing 2 requires for this invention are the expanded sectional view of organic EL side luminescence panel 12. The liquid crystal display 11 of this operation gestalt is composition which has arranged the filter array 32 in the front face of the white photosynthesis layer 16 in organic EL side luminescence panel 12 as shown in drawing 2 . In addition, other composition in this operation gestalt is the same as the composition of the above-mentioned operation gestalt 1.

[0022] As shown in drawing 2 and drawing 3 , the filter array 32 is arranged so that red filter section 32R corresponding to blue-red PL section 16R, green filter section 32G corresponding to blue and green PL section 16G, and blue filter section 32B and ** corresponding to blue and blue PL section 16B of the white photosynthesis layer 16 may adjoin mutually.

[0023] If electric field are impressed between the anode electrode 17 and the cathode electrode 19 as shown in drawing 3 , field luminescence of the blue glow B will be carried out from the organic EL layer 18. Incidence of this blue glow B is carried out to blue-red PL section 16R, blue and green PL section 16G, and blue and blue PL section 16B, and it becomes the red light R, green light G, and blue-glow B', respectively. As for the light by which outgoing radiation was carried out from each [these] PL section, color purity is raised in each part of the filter array 32. For this reason, additive mixture of colors are carried out by each light from the filter array 32, and the white light with high purity can be generated. Especially, since good white is realizable in this operation gestalt, the on-the-strength balance of each color can be set up by adjusting the light transmittance of each part of the filter array 32. Moreover, since red filter section 32R, green filter section 32G, and blue filter section 32B are arranged, respectively on blue and blue-red PL section 16R, blue and green PL section 16G, and blue PL section 16B, When the blue glow B generated in organic EL element 15 escapes from blue and blue-red PL section 16R, blue and green PL section 16G, and blue PL section 16B and comes out, it can prevent that the blue glow B carries out incidence to the liquid crystal display panel 13 side. For this reason, even if it makes high the radiant power output of organic EL element 15, a blue glow B falls out, and does not come out, and a good liquid crystal display with high brightness is made possible. In addition, blue filter section 32B is not arranged, or the outgoing radiation of the blue glow may be made to be carried out in this operation gestalt, to the liquid crystal display panel 13 side, although blue filter section 32B has been arranged on blue and blue PL section 16B as it is as area pellucida.

[0024] (Operation gestalt 3) Drawing 4 is the cross section showing the operation gestalt 3 of the liquid crystal display concerning this invention. With this operation gestalt, the diffusion board 33 which has light-transmission nature in the front face of the white photosynthesis layer 16 in organic EL side luminescence panel 12, and has optical diffusibility is arranged. In addition, other composition in this operation gestalt is the same as that of the above-mentioned operation gestalt 1. In this operation gestalt, by diffusing more the light generated in each PL section of the white photosynthesis layer 16, while making it uniform field luminescence, the color purity of the white light by which additive mixture of colors were carried out can be raised, and a display performance can be raised.

[0025] (Operation gestalt 4) Drawing 5 is the cross section showing the operation gestalt 4 of the liquid crystal display concerning this invention. With this operation gestalt, the micro-lens array 34 is arranged in the front face of the white photosynthesis layer 16 in organic EL side luminescence panel 12. In addition, other composition in this operation gestalt is the same as that of the above-mentioned operation gestalt 1. since there is an operation which makes it spread after condensing the light generated in each PL section of the white photosynthesis layer 16 by the micro-lens array 34 in this operation gestalt, while the effect which mixes the light by which outgoing radiation was carried out from each PL section becomes high, consequently making it uniform field luminescence, raising the color purity which is the white light by which additive mixture of colors were carried out comes out For this reason, also in this operation gestalt, the display performance of a liquid crystal display 11 can be raised.

[0026] (Operation gestalt 5) Drawing 6 is the cross section showing the operation gestalt 5 of the liquid crystal display concerning this invention. Organic EL side luminescence panel 12 in this operation gestalt is the same as that of the operation gestalt 1 which the composition by the side of the rear face of the transparent EL substrate 14 described above, and organic EL element 15 is formed. in the front face of the transparent EL substrate 14, it corresponds to each pixel section (field where a front liquid crystal drive electrode and a back liquid crystal drive electrode cross) of the liquid crystal display panel 13 -- as -- respectively -- pixel area and abbreviation -- PL layer which has the same area is arranged and formed As a PL layer, as shown in drawing 6 , there are blue-red PL layer 35R, blue and green PL layer 35G, and blue and blue PL layer 35B. These PL layers are formed in the predetermined array so that it may correspond with each pixel of the liquid crystal display panel 13 which carries out a postscript.

[0027] Next, the composition of the liquid crystal display panel 13 in this operation gestalt is explained. The liquid crysta! display panel 13 of this operation gestalt is not equipped with the light filter. That is, two or more front liquid crystal drive

electrodes 25 are formed in the rear face of the front transparent substrate 20 in the shape of a stripe. The black mask 23 is formed among these before liquid crystal drive electrode 25. And the last orientation film 26 is formed in the front liquid crystal drive electrode 25 and the rear face (opposite medial surface) of the black mask 23. In addition, other composition in the liquid crystal display panel 13 is the same as that of the above-mentioned operation gestalt 1.

[0028] The operation and operation in the liquid crystal display 11 of this operation form are explained. First, if direct current voltage or pulse-shape voltage is impressed between the anode electrode 17 of organic EL element 15, and the cathode electrode 19, a blue glow will occur from the organic EL layer 18. This blue glow is blue and blue-red PL layer 35R, blue and green PL layer 35G, and blue PL layer 35B, and generates and carries out outgoing radiation of red light, green light, and the blue glow, respectively. Incidence of this outgoing radiation light is carried out to the liquid crystal display panel 13, and liquid crystal 29 is covered by transparency or liquid crystal 29 according to the orientation state of the liquid crystal 29 of each pixel section. As for the light of each transmitted color, a brilliance control is performed according to the orientation state of liquid crystal 29. And it becomes possible by performing pixel selection by the liquid crystal display panel 13 to perform color display free.

[0029] Since PL layer which emits light in the color according to the foreground color of each pixel for every pixel is prepared in the electrochromatic display display panel 13 in this operation gestalt A multicolor display can be performed without using a light filter, while not emitting light in the non-display field covered with the black mask 23. The rate of the brightness of the light which carries out a spectrum and displays the white containing each foreground color to the brightness of the luminescent color of PL layer compared with absorption and the liquid crystal display which indicates by multicolor can be high, and can improve the transparency efficiency of light sharply. Moreover, since light of R, G, and B is realized using high PL layer of photoluminescence efficiency while using organic EL element 15 which performs blue luminescence with organic efficient EL side luminescence panel 12, the efficiency for light utilization as the liquid crystal display 11 whole can be raised sharply. Moreover, there is an advantage that power consumption is reducible, by having raised efficiency for light utilization in this way.

[0030] (Operation gestalt 6) Drawing 7 is the cross section showing the operation gestalt 6 of the liquid crystal display concerning this invention. In this operation gestalt, in order to raise the color purity of the light by which outgoing radiation is carried out to the front face of each PL layers 35R, 35G, and 35B of organic EL side luminescence panel 13 of the above-mentioned operation gestalt 5 by generating in each PL layer, it is the composition arranged, respectively so that red filter layer 36R, green filter layer 36G, and blue filter layer 36B may correspond. In addition, other composition in this operation gestalt is the same in the above-mentioned operation gestalt 5.

[0031] In this operation gestalt, the blue glow generated in organic EL element 15 Blue-red PL layer 35R, When it escapes from blue and green PL layer 35G, and blue and blue PL layer 35B and comes out, or when the luminescence wavelength region of each PL layers 35R, 35G, and 35B is broadcloth Since it has the operation which carries out outgoing radiation of the light of the operation which absorbs components other than the light to which outgoing radiation of the filter layer arranged on these PL layer was carried out by the modulation, or the wavelength region of a sharp peak, it is set up so that the color purity of the light which carries out incidence to each pixel section of the liquid crystal display panel 13 can be raised. Moreover, since omission **** of a blue glow can be prevented even if it sets up the luminescence intensity of organic EL element 15 highly, it becomes possible to perform the display of high brightness.

[0032] (Operation gestalt 7) Drawing 8 is the cross section showing the operation gestalt 7 of the liquid crystal display concerning this invention. In this operation gestalt, they are TFT 42 which has the semiconductor layer which consists of a-Si connected to each backward liquid crystal drive electrode 27 of the liquid crystal display 11 of the above-mentioned operation gestalt 5, and the composition of having formed the black mask 41 which shades luminescence of PL layer from TFT 42 among each PL layers 35R, 35G, and 35B of organic EL side luminescence panel 13. In addition, other composition in this operation gestalt is the same in the above-mentioned operation gestalt 5. With the operation gestalt 7, since outdoor daylight can be shaded with the black mask 23 and the black mask 41 shades luminescence of organic EL side luminescence panel 12, the incidence of the excitation light which generates the carrier to a semiconductor layer can be suppressed, and the incorrect operation of TFT 42 can be prevented.

[0033] As mentioned above, although the operation gestalt 1 - the operation gestalt 7 were explained, various kinds of change which is not limited to these and accompanies the summary of composition is possible for this invention. For example, although it is the composition that the laminating of the ** was carried out to the luminous layer which 96wt(s)% and BCzVBi become from 4wt(s)%, and the electronic transporting bed which consists of Alq3, if the electron hole transporting bed which consists of alpha-NPD in each above-mentioned operation gestalt as an organic EL layer 18 which generates a blue glow, and DPVBi are organic EL material layers which generate a blue glow substantially, they will not be limited to this. Moreover, in each above-mentioned operation gestalt, if the blue glow by which outgoing radiation is carried out from the organic EL layer 18 in a blue glow although blue and blue PL section 16B, and blue and blue PL layer 35B were used is suitable for a wavelength region as a display light as it is, even if it omits blue and blue PL section 16B, and blue and blue PL layer 35B, it is easy to be natural.

[0034] Moreover, in each above-mentioned operation gestalt, although each PL section is arranged to the front-face side of the transparent EL substrate 14 and organic EL element 15 was formed in the rear-face side, of course, it is also possible to consider as the composition which forms organic EL element 15 on the transparent EL substrate 14, and arranges each PL section on this organic EL element 15. Moreover, you may form a protective coat on the white photosynthesis layer 16.

[0035] Furthermore, in each above-mentioned operation gestalt, although the organic EL layer 18 considered as the composition which generates a blue glow, you may constitute from material which carries out origin light of the light of other wavelength regions, for example, ultraviolet radiation, the purple-blue light, etc., and is generated. In this case, what is necessary is just to set up so that the PL section and PL layer may modulate such origin light in the light of R, G, and B.
[0036] Furthermore, in each above-mentioned operation gestalt, although the liquid crystal display panel 13 considered as the composition by simple matrix drive, it is easy to be natural also as composition of the active drive method equipped with the TFT as a pixel electrode or a switching element. Moreover, of course, liquid crystal display mode can also be changed suitably, and the existence of a polarizing plate is also suitably changed according to the liquid crystal display mode. In liquid crystal mode like especially PDLC, since it functions without a polarizing plate as an optical shutter, the high display of brightness can be performed. Furthermore, although the PL section and PL layer were prepared in organic EL side luminescence panel 12 side with each above-mentioned operation gestalt, it is easy to be natural also as composition prepared in these liquid crystal display panel 13 side. By the time of Ming, the above-mentioned liquid crystal display may reflect and display outdoor daylight by the cathode electrode 19 as a reflected type, and in the time of dark, it may make selection possible so that organic EL side luminescence panel 12 may be made to emit light as a penetrated type and it may display.
[0037]
[Effect of the Invention] According to this invention, the homogeneity within a field of white luminescence is equipped with the back light system which performs efficient luminescence high moreover, and does so the effect of realizing the liquid crystal display which can perform good color display so that clearly from the above explanation. Moreover, the effect of realizing the liquid crystal display which ** and color display of high luminous efficiency can be made [liquid crystal display] possible by this invention, and can decrease power consumption is done so.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

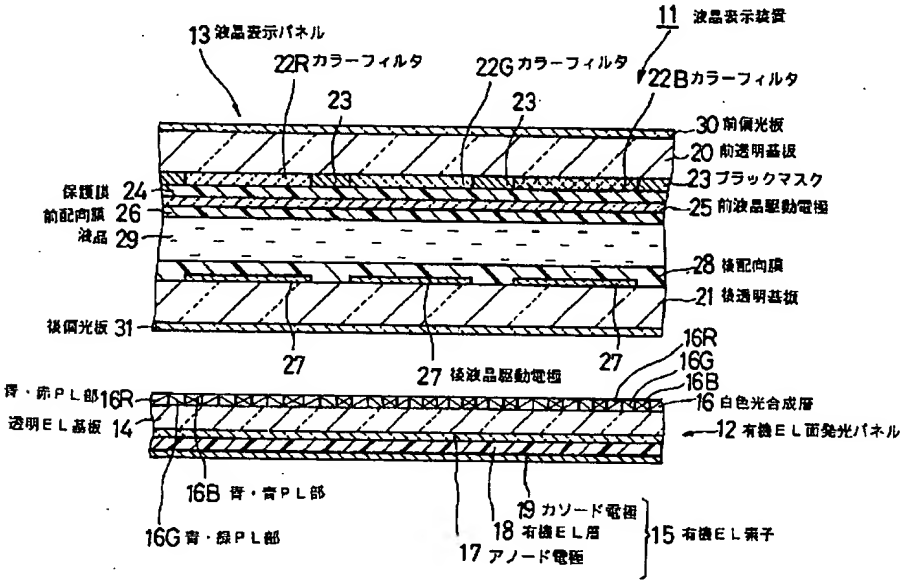
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The cross section showing the operation gestalt 1 of the liquid crystal display concerning this invention.
[Drawing 2] The cross section showing the operation gestalt 2 of the liquid crystal display concerning this invention.
[Drawing 3] The expanded sectional view of the operation gestalt 2.
[Drawing 4] The cross section showing the operation gestalt 3 of the liquid crystal display concerning this invention.
[Drawing 5] The cross section showing the operation gestalt 4 of the liquid crystal display concerning this invention.
[Drawing 6] The cross section showing the operation gestalt 5 of the liquid crystal display concerning this invention.
[Drawing 7] The cross section showing the operation gestalt 6 of the liquid crystal display concerning this invention.
[Drawing 8] The cross section showing the operation gestalt 7 of the liquid crystal display concerning this invention.
[Drawing 9] The cross section showing the conventional liquid crystal display.
[Description of Notations]
11 Liquid Crystal Display
12 Organic EL Side Luminescence Panel
13 Liquid Crystal Display Panel
15 Organic EL Element
16 White Photosynthesis Layer
16R Blue-red PL section
16G Blue and the green PL section
16B Blue and the blue PL section
32 Filter Array
33 Diffusion Board
34 Micro-Lens Array
35R Blue-red PL layer
35G Blue and a green PL layer
35B Blue and a blue PL layer

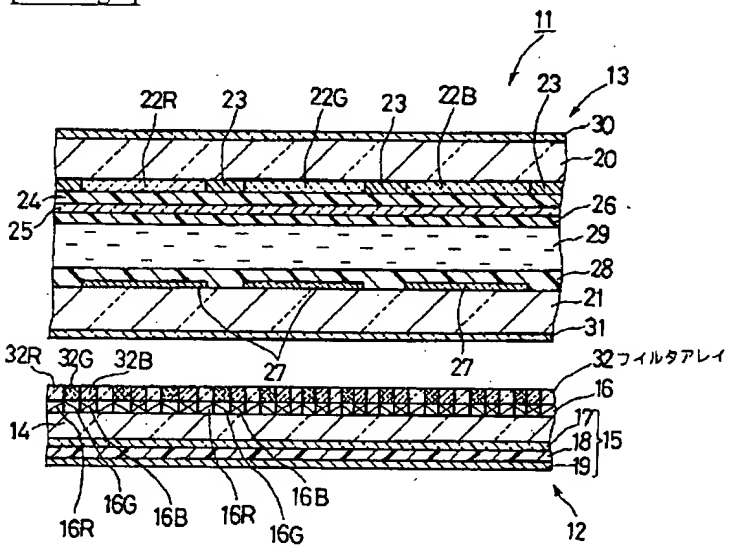
[Translation done.]

DRAWINGS

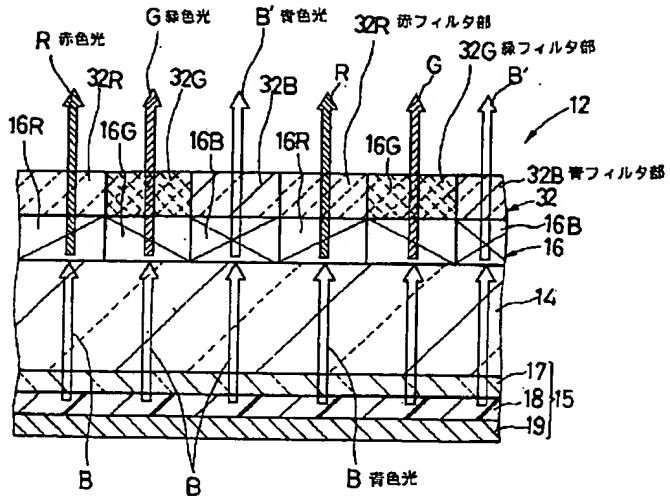
[Drawing 1]



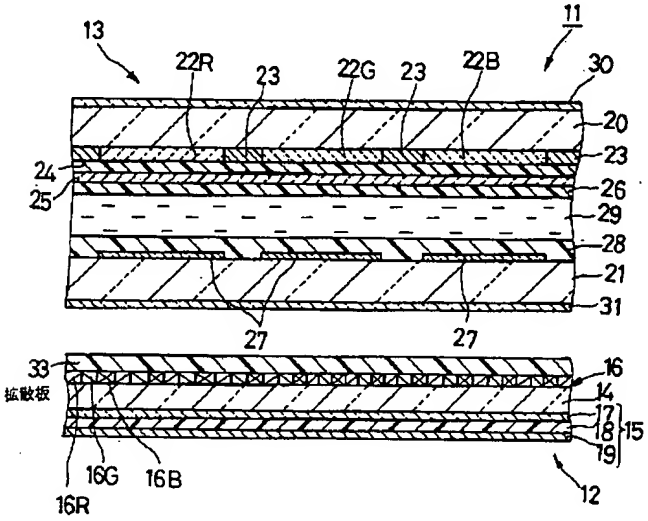
[Drawing 2]



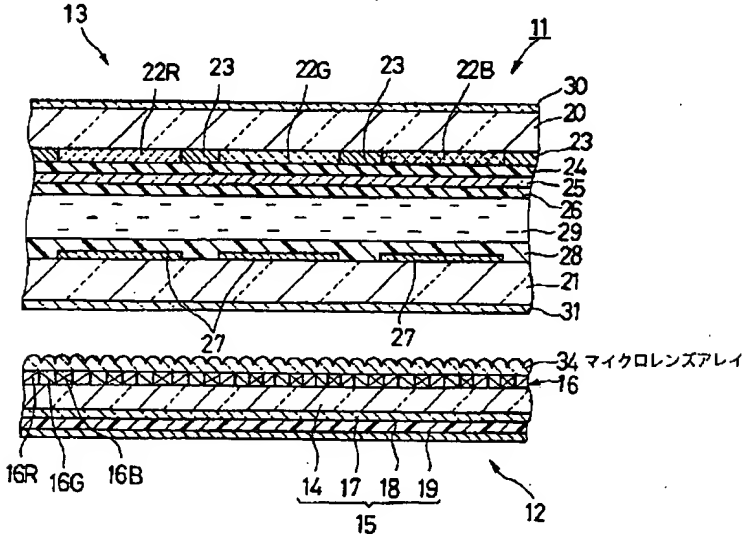
[Drawing 3]



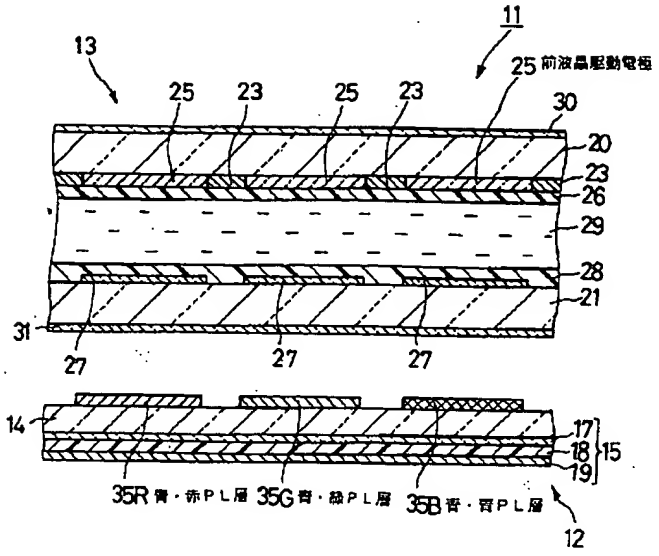
[Drawing 4]



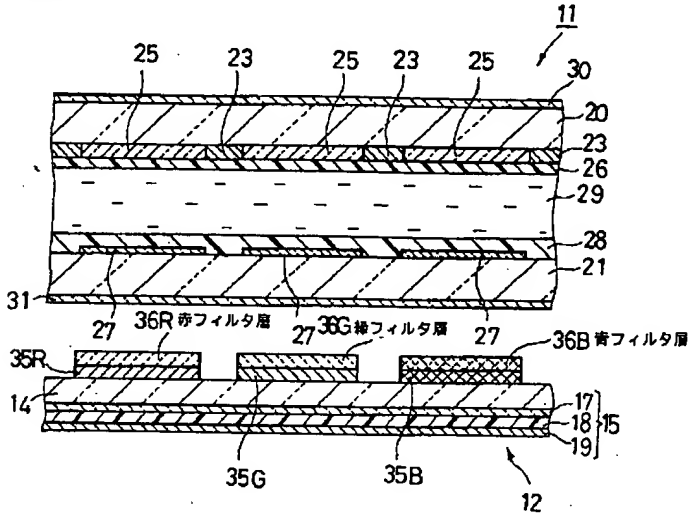
[Drawing 5]



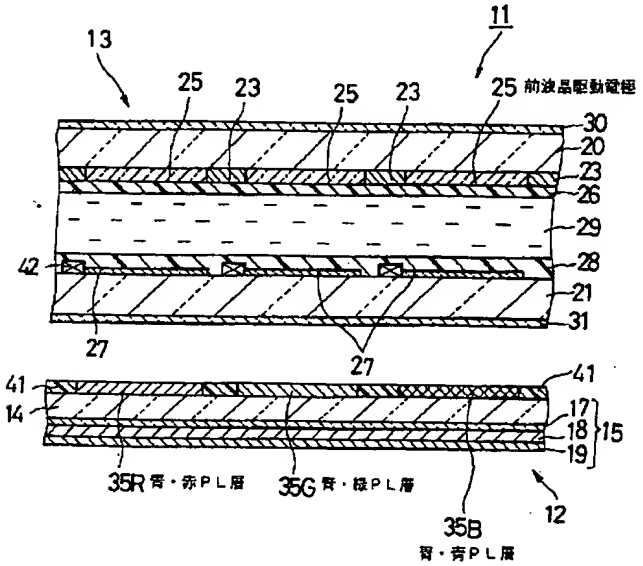
[Drawing 6]



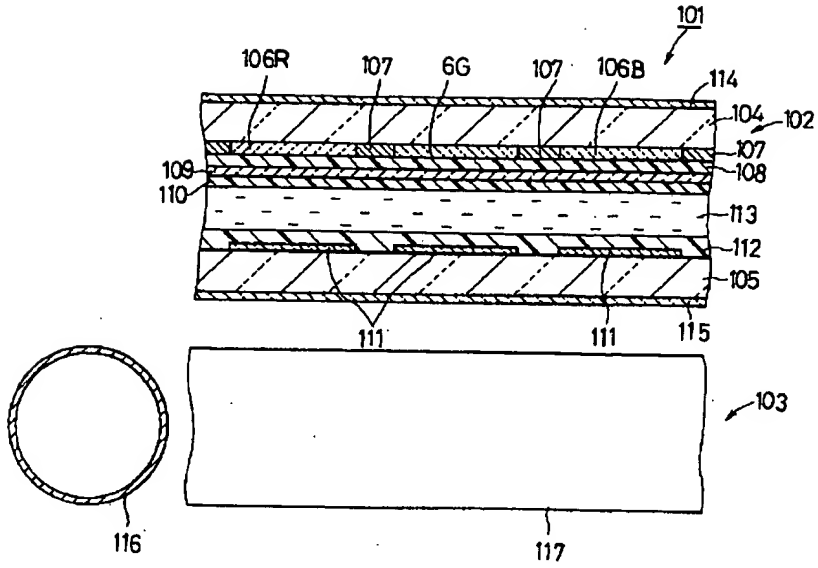
[Drawing 7]



[Drawing 8]



[Drawing 9]



[Translation done.]

MEANS

[Means for Solving the Problem] In the liquid crystal display, invention according to claim 1 is characterized by having arranged two or more photoluminescence meanses to absorb the wavelength region of the light generated in this organic EL element between the aforementioned liquid crystal display panel and the aforementioned organic EL element, and to generate the light of a wavelength region mutually different, respectively while it is equipped with the organic EL element which performs field luminescence behind a liquid crystal display panel corresponding to the viewing area of the aforementioned liquid crystal display panel.

[0009] In invention according to claim 1, the light generated in the organic EL element is absorbed with a photoluminescence means, and the light of a characteristic wavelength region is generated with each photoluminescence means. Incidence of the light generated with the photoluminescence means of these plurality is carried out to a liquid crystal display panel, and it turns into light for a display. By considering as such composition, the light of the same color occurs uniformly in the field of an organic EL element, and in order to generate the light of the wavelength region where the photoluminescence meanses which absorbed this light differ, respectively, it becomes possible to perform color display by the side of a liquid crystal display panel. Moreover, by using a photoluminescence means, it becomes possible to perform good luminescence of energy efficiency using the light generated in the organic EL element, and a liquid crystal display with high display brightness is made possible.

[0010]

[Embodiments of the Invention] It explains based on each operation form which shows the detail of the liquid crystal display concerning this invention hereafter to a drawing.

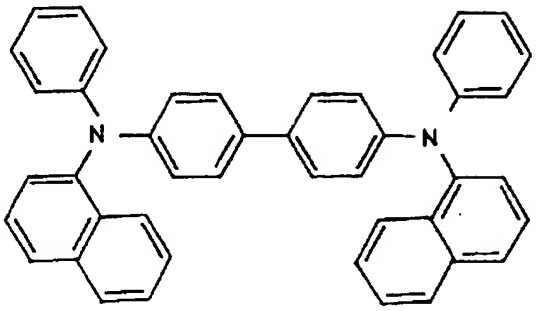
(Operation form 1) Drawing 1 is the cross section showing the operation form 1 of the liquid crystal display concerning this invention. 11 are a liquid crystal display among drawing. This liquid crystal display 11 consists of an organic EL side luminescence panel 12 and a liquid crystal display panel 13, as shown in this drawing.

[0011] First, the composition of organic EL side luminescence panel 12 is explained. The field behind the transparent EL substrate 14 which becomes by glass or synthetic resin as organic EL side luminescence panel 12 is shown in drawing 1 (lower part in drawing) Organic EL element 15 which has a luminescence field corresponding to a side with the viewing area of the liquid crystal display panel 13 is formed. (It is hereafter called a rear face) It is formed so that the white photosynthesis layer 16 as a photoluminescence (henceforth PL) array may correspond to the field (henceforth front face) side ahead of the transparent EL substrate 14 (upper part in drawing) with the luminescence field of organic EL element 15.

[0012] One by one, the laminating of the anode electrode 17, the organic EL layer 18, and the cathode electrode 19 is carried out, and organic EL element 15 becomes the rear face of the transparent EL substrate 14, as shown in this drawing. For example, it is transparent, it is ITO (indium tin oxide), and the anode electrode 17 is formed so that it may correspond with the viewing area of the liquid crystal display panel 13. The organic EL layer 18 is N and N'-JI (alpha-naphthyl) to the order from the anode electrode 17 side. - N and N'-diphenyl -1, the 1'-biphenyl -4, and the electron hole transporting bed that consists of a 4'-diamine (henceforth alpha-NPD), A 4 and 4'-screw (2 and 2'-diphenyl vinylene) biphenyl The luminous layer which 96wt(s)% and a 4 and 4'-screw (2-carbazole vinylene) biphenyl (henceforth BCzVBi) become [(it is hereafter called DPVBi)] from 4wt(s)%, The laminating of the electronic transporting bed and ** which consist of a tris (8-hydroxyquinoline) aluminum complex (henceforth Alq3) is carried out, and they are constituted. ** [impression of electric field / generate / a blue glow / the organic EL layer 18 formed of such a material layer] The luminescence field of this organic EL layer 18 is set up so that it may correspond with the viewing area of the liquid crystal display panel 13. Below, alpha-NPD, DPVBi, BCzVBi, and the structure expression of Alq3 are shown.

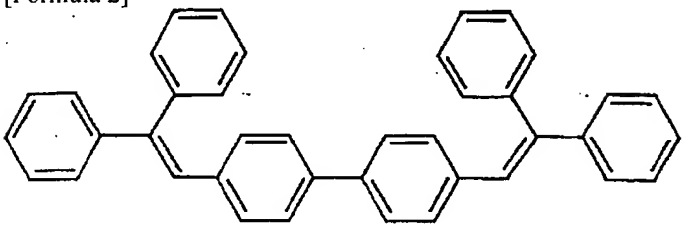
[0013]

[Formula 1]



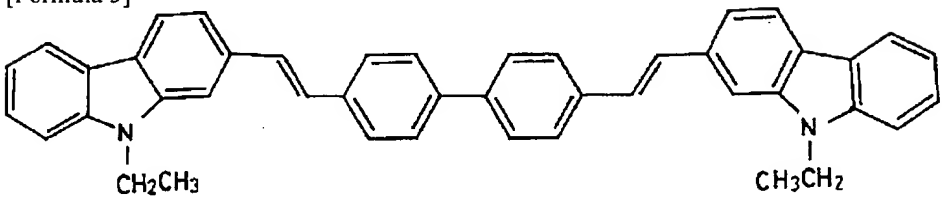
α－NPD

[Formula 2]

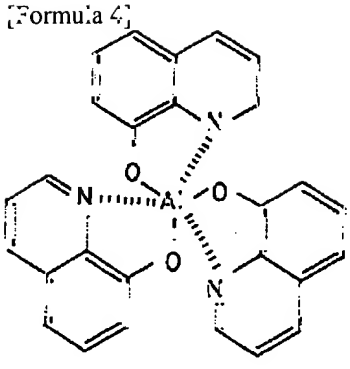


DPVBi

[Formula 3]



[Formula 4]



Alq3

[0014] And the cathode electrode 19 formed in the rear face of the organic EL layer 18 is formed by metal material with the property to be easy to pour in a carrier to the organic EL layer 18, for example, MgIn, AlLi, etc. This cathode electrode 19 is also formed so that it may correspond with the viewing area of the liquid crystal display panel 13. In addition, although illustration is not carried out, the protective coat covered from water and oxygen all over organic EL-element 15 is formed.

[0015] Next, the composition of the white photosynthesis layer 16 formed in the front-face side of the transparent EL

substrate 14 is explained. Blue-red PL section 16R which this white photosynthesis layer 16 absorbs the light of a blue wavelength region, and newly generates the light of a red wavelength region, The blue and green PL section 16G which absorb the light of a blue wavelength region and newly generate the light of a green wavelength region, The blue and blue PL section 16B which absorbs the light of a blue wavelength region and generates the light of a blue wavelength color, it adjoins mutually in the array of ****** -- as -- arranging -- the occupancy area of each PL section -- an area of 1 pixel of a liquid crystal display panel -- comparing -- enough -- being detailed (desirable -- 1/3 or less area of 1-pixel area) -- it is set up so that it may become In addition, as a material which constitutes these PL section, a well-known photoluminescence material is applicable.

[0016] In the above, although the composition of organic EL side luminescence panel 12 was explained, the liquid crystal display panel 13 is explained below. In addition, with this operation form, the thing of composition of using a simple matrix drive method as a liquid crystal display panel 13 is applied.

[0017] Hereafter, the concrete composition of the liquid crystal display panel 13 of this operation form is explained. The liquid crystal display panel 13 of this operation form has the front transparent substrate 20 and the back transparent substrate 21. The light filters 22R, 22G, and 22B of R, G, and B are formed in the opposite inside side of the front transparent substrate 20 in the predetermined array. Moreover, the black mask 23 is formed between light filters 22R and 22G and 22B. Furthermore, these light filters 22R, 22G, and 22B and the black mask 23 are covered by the protective coat 24. Two or more front liquid crystal drive electrodes 25 which are formed in parallel, respectively and make the shape of a stripe are formed in the opposite inside side of a protective coat 24, and the last orientation film 26 is formed in it so that these before liquid crystal drive electrode 25 may be covered. On the other hand, two or more back liquid crystal drive electrodes 27 formed in the direction which intersects the above-mentioned front liquid crystal drive electrode 25 at parallel, respectively are arranged in the opposite inside side of the back transparent substrate 21. In addition, the field (pixel field) where the front liquid crystal drive electrode 25 and the back liquid crystal drive electrode 27 cross is set up so that it may correspond with each above-mentioned light filters 22R, 22G, and 22B. Moreover, it is covered by the back orientation film 28 in the back transparent substrate 21 and the back liquid crystal drive electrode 27. And liquid crystal 29 is enclosed with the gap which the front transparent substrate 20 and the back transparent substrate 21 are stuck through the sealant which is not illustrated so that each orientation film 26 and 28 may counter, and is formed by both the orientation films 26 and 28 and the sealant. Furthermore, the front polarizing plate 30 is arranged in the opposite outside side (front face) of the front transparent substrate 20, and the back polarizing plate 31 is arranged in the opposite outside side (rear face) of the back transparent substrate 21.

[0018] Next, an operation and operation of the liquid crystal display 11 of such composition are explained. When displaying by the liquid crystal display panel 13, by carrying out the line sequential drive of the front liquid crystal drive electrode 25 and the back liquid crystal drive electrode 27, electric field are impressed to liquid crystal 29, and it drives so that liquid crystal 29 may become predetermined orientation according to the intensity of electric field. By the light by which outgoing radiation was carried out from organic EL side luminescence panel 12 according to the orientation state of this liquid crystal 29 penetrating the pixel section, or being intercepted, a display becomes possible. the light which penetrated each light filter since each pixel section of the liquid crystal display panel 13 was equipped with light filters 22R, 22G, and 22B, respectively at this time -- the spectrum of a light filter -- outgoing radiation of the light of the color of R, G, and B is carried out by operation, respectively

[0019] By the way, with this operation form, if electric field are impressed between the anode electrode 17 and the cathode electrode 19 in organic EL element 15, a blue glow will occur from the organic EL layer 18. Since the cathode electrode 19 is the metal material of light reflex nature, this blue glow penetrates the transparent EL substrate 14, and it carries out incidence to the white photosynthesis layer 16. At this time, in the white photosynthesis layer 16, it is blue-red PL section 16R, and the light of the blue wavelength region from organic EL element 15 is absorbed, and the light of a red wavelength region is newly generated. Moreover, in blue and green PL section 16G, the light of a blue wavelength region is absorbed and the light of a green wavelength region is newly generated. Furthermore, in blue and blue PL section 16B, the light of a blue wavelength region is absorbed and the light of a wavelength color with more blue long wavelength is generated. Moreover, as described above, since these PL sections 16R, 16G, and 16B are arranged, respectively so that it may become detailed enough as compared with an area of 1 pixel of a liquid crystal display panel, and it may be set up and may adjoin mutually in a predetermined array, to each PL section front, a detailed beam light of R, G, and B generates them. Since the beam light of these large number is diffused in radiation, it turns into the white light by additive mixture of colors. And in each pixel section of the above-mentioned liquid crystal display panel 13, this white light is penetrated or intercepted according to the orientation state of liquid crystal 29. When the white light penetrates the pixel section, a spectrum is carried out by the light filter and a desired color specification light can be obtained. By such operation, color display becomes possible with the liquid crystal display 11 of this operation form.

[0020] Although it is generally so efficient that photoluminescence material has the near wavelength region of absorption light which serves as excitation energy to the wavelength region of excitation light, especially with this operation form Since it has the operation which the blue glow which is the light by the side of a short wavelength region most among the lights is absorbed [operation], and generates the light of the predetermined wavelength region of a long wavelength region more in each PL section which constitutes the white photosynthesis layer 16, since the photoluminescence efficiency of the light is very high, Energy loss can be suppressed low. For this reason, luminescence from organic EL element 15 can be used effectively for the maximum. Moreover, in organic EL side luminescence panel 12, homogeneity within a field of white

luminescence can be made high by operation of the white photosynthesis layer 16. Furthermore, organic EL side luminescence panel 12 is the composition equipped with organic EL element 15 which generates the high blue glow of luminous efficiency from the first, since an efficient new light can be generated in the white photosynthesis layer 16 by making this blue glow into the origin, can make the brightness of display light high and can perform the good display of contrast. Moreover, with this operation form, in order to use organic EL element 15 which performs field luminescence, it has the advantage that-izing of the back light system can be carried out [thin shape]. Since organic EL element 15 is a low-battery direct-current drive, it has the advantage that adjustable [of brightness / continuous] is easy as compared with an element like a cold cathode tube or an inorganic EL element which carries out a high-voltage alternating current drive, and desired brightness can be set up according to specification environment further again.

[0021] (Operation form 2) The cross section and drawing 2 which show the operation form 2 of the liquid crystal display which drawing 2 requires for this invention are the expanded sectional view of organic EL side luminescence panel 12. The liquid crystal display 11 of this operation form is composition which has arranged the filter array 32 in the front face of the white photosynthesis layer 16 in organic EL side luminescence panel 12 as shown in drawing 2 . In addition, other composition in this operation form is the same as the composition of the above-mentioned operation form 1.

[0022] As shown in drawing 2 and drawing 3 , the filter array 32 is arranged so that red filter section 32R corresponding to blue-red PL section 16R, green filter section 32G corresponding to blue and green PL section 16G, and blue filter section 32B and ** corresponding to blue and blue PL section 16B of the white photosynthesis layer 16 may adjoin mutually.

[0023] If electric field are impressed between the anode electrode 17 and the cathode electrode 19 as shown in drawing 3 , field luminescence of the blue glow B will be carried out from the organic EL layer 18. Incidence of this blue glow B is carried out to blue-red PL section 16R, blue and green PL section 16G, and blue and blue PL section 16B, and it becomes the red light R, green light G, and blue-glow B', respectively. As for the light by which outgoing radiation was carried out from each [these] PL section, color purity is raised in each part of the filter array 32. For this reason, additive mixture of colors are carried out by each light from the filter array 32, and the white light with high purity can be generated. Especially, since good white is realizable in this operation form, the on-the-strength balance of each color can be set up by adjusting the light transmittance of each part of the filter array 32. Moreover, since red filter section 32R, green filter section 32G, and blue filter section 32B are arranged, respectively on blue and blue-red PL section 16R, blue and green PL section 16G, and blue PL section 16B, When the blue glow B generated in organic EL element 15 escapes from blue and blue-red PL section 16R, blue and green PL section 16G, and blue PL section 16B and comes out, it can prevent that the blue glow B carries out incidence to the liquid crystal display panel 13 side. For this reason, even if it makes high the radiant power output of organic EL element 15, a blue glow B falls out, and does not come out, and a good liquid crystal display with high brightness is made possible. In addition, blue filter section 32B is not arranged, or the outgoing radiation of the blue glow may be made to be carried out in this operation form, to the liquid crystal display panel 13 side, although blue filter section 32B has been arranged on blue and blue PL section 16B as it is as the transparent section.

[0024] (Operation form 3) Drawing 4 is the cross section showing the operation form 3 of the liquid crystal display concerning this invention. With this operation form, the diffusion board 33 which has light-transmission nature in the front face of the white photosynthesis layer 16 in organic EL side luminescence panel 12, and has optical diffusibility is arranged. In addition, other composition in this operation form is the same as that of the above-mentioned operation form 1. In this operation form, by diffusing more the light generated in each PL section of the white photosynthesis layer 16, while making it uniform field luminescence, the color purity of the white light by which additive mixture of colors were carried out can be raised, and a display performance can be raised.

[0025] (Operation form 4) Drawing 5 is the cross section showing the operation form 4 of the liquid crystal display concerning this invention. With this operation form, the micro-lens array 34 is arranged in the front face of the white photosynthesis layer 16 in organic EL side luminescence panel 12. In addition, other composition in this operation form is the same as that of the above-mentioned operation form 1. since there is an operation which makes it spread after condensing the light generated in each PL section of the white photosynthesis layer 16 by the micro-lens array 34 in this operation form, while the effect which mixes the light by which outgoing radiation was carried out from each PL section becomes high, consequently making it uniform field luminescence, raising the color purity which is the white light by which additive mixture of colors were carried out comes out For this reason, also in this operation form, the display performance of a liquid crystal display 11 can be raised.

[0026] (Operation form 5) Drawing 6 is the cross section showing the operation form 5 of the liquid crystal display concerning this invention. Organic EL side luminescence panel 12 in this operation form is the same as that of the operation form 1 which the composition by the side of the rear face of the transparent EL substrate 14 described above, and organic EL element 15 is formed. in the front face of the transparent EL substrate 14, it corresponds to each pixel section (field where a front liquid crystal drive electrode and a back liquid crystal drive electrode cross) of the liquid crystal display panel 13 -- as -- respectively -- pixel area and abbreviation -- PL layer which has the same area is arranged and formed As a PL layer, as shown in drawing 6 , there are blue-red PL layer 35R, blue and green PL layer 35G, and blue and blue PL layer 35B. These PL layers are formed in the predetermined array so that it may correspond with each pixel of the liquid crystal display panel 13 which carries out a postscript.

[0027] Next, the composition of the liquid crystal display panel 13 in this operation form is explained. The liquid crystal display panel 13 of this operation form is not equipped with the light filter. That is, two or more front liquid crystal drive

electrodes 25 are formed in the rear face of the front transparent substrate 20 in the shape of a stripe. The black mask 23 is formed among these before liquid crystal drive electrode 25. And the last orientation film 26 is formed in the front liquid crystal drive electrode 25 and the rear face (opposite inside side) of the black mask 23. In addition, other composition in the liquid crystal display panel 13 is the same as that of the above-mentioned operation form 1.

[0028] The operation and operation in the liquid crystal display 11 of this operation form are explained. First, if direct current voltage or pulse-shape voltage is impressed between the anode electrode 17 of organic EL element 15, and the cathode electrode 19, a blue glow will occur from the organic EL layer 18. This blue glow is blue and blue-red PL layer 35R, blue and green PL layer 35G, and blue PL layer 35B, and generates and carries out outgoing radiation of red light, green light, and the blue glow, respectively. Incidence of this outgoing radiation light is carried out to the liquid crystal display panel 13, and liquid crystal 29 is covered by transparency or liquid crystal 29 according to the orientation state of the liquid crystal 29 of each pixel section. As for the light of each transmitted color, a brilliance control is performed according to the orientation state of liquid crystal 29. And it becomes possible by performing pixel selection by the liquid crystal display panel 13 to perform color display free.

[0029] Since PL layer which emits light in the color according to the foreground color of each pixel for every pixel is prepared in the electrochromatic display display panel 13 in this operation form A multicolor display can be performed without using a light filter, while not emitting light in the non-display field covered with the black mask 23. The rate of the brightness of the light which carries out a spectrum and displays the white containing each foreground color to the brightness of the luminescent color of PL layer compared with absorption and the liquid crystal display which indicates by multicolor can be high, and can improve the transparency efficiency of light sharply. Moreover, since light of R, G, and B is realized using high PL layer of photoluminescence efficiency while using organic EL element 15 which performs blue luminescence with organic efficient EL side luminescence panel 12, the efficiency for light utilization as the liquid crystal display 11 whole can be raised sharply. Moreover, there is an advantage that power consumption is reducible, by having raised efficiency for light utilization in this way.

[0030] (Operation form 6) Drawing 7 is the cross section showing the operation form 6 of the liquid crystal display concerning this invention. In this operation form, in order to raise the color purity of the light by which outgoing radiation is carried out to the front face of each PL layers 35R, 35G, and 35B of organic EL side luminescence panel 13 of the above-mentioned operation form 5 by generating in each PL layer, it is the composition arranged, respectively so that red filter layer 36R, green filter layer 36G, and blue filter layer 36B may correspond. In addition, other composition in this operation form is the same in the above-mentioned operation form 5.

[0031] In this operation gestalt, the blue glow generated in organic EL element 15 Blue-red PL layer 35R, When it escapes from blue and green PL layer 35G, and blue and blue PL layer 35B and comes out, or when the luminescence wavelength region of each PL layers 35R, 35G, and 35B is broadcloth Since it has the operation which carries out outgoing radiation of the light of the operation which absorbs components other than the light to which outgoing radiation of the filter layer arranged on these PL layer was carried out by the modulation, or the wavelength region of a sharp peak, it is set up so that the color purity of the light which carries out incidence to each pixel section of the liquid crystal display panel 13 can be raised. Moreover, since omission **** of a blue glow can be prevented even if it sets up the luminescence intensity of organic EL element 15 highly, it becomes possible to perform the display of high brightness.

[0032] (Operation form 7) Drawing 8 is the cross section showing the operation form 7 of the liquid crystal display concerning this invention. In this operation form, they are TFT 42 which has the semiconductor layer which consists of a-Si connected to each backward liquid crystal drive electrode 27 of the liquid crystal display 11 of the above-mentioned operation form 5, and the composition of having formed the black mask 41 which shades luminescence of PL layer from TFT 42 among each PL layers 35R, 35G, and 35B of organic EL side luminescence panel 13. In addition, other composition in this operation form is the same in the above-mentioned operation form 5. With the operation form 7, since outdoor daylight can be shaded with the black mask 23 and the black mask 41 shades luminescence of organic EL side luminescence panel 12, the incidence of the excitation light which generates the carrier to a semiconductor layer can be suppressed, and the incorrect operation of TFT 42 can be prevented.

[0033] As mentioned above, although the operation form 1 - the operation form 7 were explained, various kinds of change which is not limited to these and accompanies the summary of composition is possible for this invention. For example, although it is the composition that the laminating of the ** was carried out to the luminous layer which 96wt(s)% and BCzVBi become from 4wt(s)%, and the electronic transporting bed which consists of Alq3, if the electron hole transporting bed which consists of alpha-NPD in each above-mentioned operation form as an organic EL layer 18 which generates a blue glow, and DPVBi are organic EL material layers which generate a blue glow substantially, they will not be limited to this. Moreover, in each above-mentioned operation form, if the blue glow by which outgoing radiation is carried out from the organic EL layer 18 in a blue glow although blue and blue PL section 16B, and blue and blue PL layer 35B were used is suitable for a wavelength region as a display light as it is, even if it omits blue and blue PL section 16B, and blue and blue PL layer 35B, it is easy to be natural.

[0034] Moreover, in each above-mentioned operation form, although each PL section is arranged to the front-face side of the transparent EL substrate 14 and organic EL element 15 was formed in the rear-face side, of course, it is also possible to consider as the composition which forms organic EL element 15 on the transparent EL substrate 14, and arranges each PL section on this organic EL element 15. Moreover, you may form a protective coat on the white photosynthesis layer 16.

[0035] Furthermore, in each above-mentioned operation form, although the organic EL layer 18 considered as the composition which generates a blue glow, you may constitute from material which carries out origin light of the light of other wavelength regions, for example, ultraviolet radiation, the purple-blue light, etc., and is generated. In this case, what is necessary is just to set up so that the PL section and PL layer may modulate such origin light in the light of R, G, and B.
[0036] Furthermore, in each above-mentioned operation form, although the liquid crystal display panel 13 considered as the composition by simple matrix drive, it is easy to be natural also as composition of the active drive method equipped with the TFT as a pixel electrode or a switching element. Moreover, of course, liquid crystal display mode can also be changed suitably, and the existence of a polarizing plate is also suitably changed according to the liquid crystal display mode. In liquid crystal mode like especially PDLC, since it functions without a polarizing plate as an optical shutter, the high display of brightness can be performed. Furthermore, although the PL section and PL layer were prepared in organic EL side luminescence panel 12 side with each above-mentioned operation form, it is easy to be natural also as composition prepared in these liquid crystal display panel 13 side. By the time of Ming, the above-mentioned liquid crystal display may reflect and display outdoor daylight by the cathode electrode 19 as a reflected type, and in the time of dark, it may make selection possible so that organic EL side luminescence panel 12 may be made to emit light as a penetrated type and it may display.

[Translation done.]

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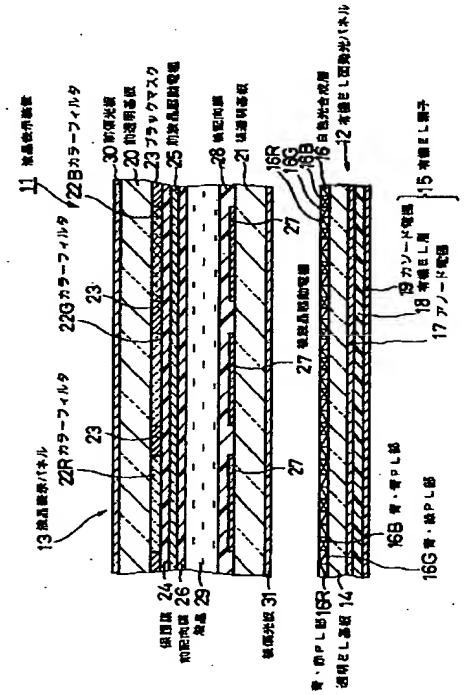
(54)【発明の名称】　液晶表示装置

(57)【要約】

【課題】　面内均一性が高い白色光が得られ、高効率な発光を行う有機ＥＬ面発光パネルを備えたカラー表示性能の高い液晶表示装置を提供する。

【解決手段】　透明基板１４の後面に、青色面発光を行う有機ＥＬ素子１５を形成し、透明基板１４の前面に、微細な青・赤ＰＬ部１６Ｒ、青・緑ＰＬ部１６Ｇ、青・青ＰＬ部１６Ｂが集合してなる白色光合成層１６を配置する。この白色光合成層１６で青色光を吸収してＲ、Ｇ、Ｂの各色の光が発生するが、これらが加法混色により白色光を構成するため、液晶表示パネル１３に白色光を照明光として供給することができる。このため、均一な面発光による良好な白色表示光を液晶表示パネルに入射でき、表示性能の高いカラー表示が可能となる。



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【特許請求の範囲】

【請求項1】　液晶表示パネルの後方に、前記液晶表示パネルの表示領域と対応して面発光を行う有機ＥＬ素子を備えるとともに、前記液晶表示パネルと前記有機ＥＬ素子との間に、該有機ＥＬ素子で発生される光の波長域を吸収して、それぞれ、互いに異なる波長域の光を発生する、複数のフォトルミネッセンス手段が配置されたことを特徴とする液晶表示装置。

【請求項2】　前記液晶表示パネルのそれぞれの画素に対応して所定のカラーフィルタが備えられることを特徴とする請求項1記載の液晶表示装置。

【請求項3】　前記フォトルミネッセンス手段は、青色光を吸収して赤色光を発生させる青・赤フォトルミネッセンス手段と、青色光を吸収して緑色光を発生させる青・緑フォトルミネッセンス手段と、青色光を吸収して青色光を発生させる青・青フォトルミネッセンス手段と、の3種類が存在することを特徴とする請求項1記載の液晶表示装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】この発明は、表示装置に関し、さらに詳しくは、バックライトとして面発光を行う電界発光素子を備えた液晶表示装置に関する。

【０００２】

【従来の技術】従来の液晶表示装置としては、例えば図９に示すような構成のものが知られている。同図に示すように、この液晶表示装置１０１は、液晶表示パネル１０２とバックライトシステム１０３とを備えている。液晶表示パネル１０２は、前透明基板１０４と後透明基板１０５とを有している。前透明基板１０４の後透明基板１０５と対向する側の面、すなわち対向内側面には、所定の配列でＲ、Ｇ、Ｂのカラーフィルタ１０６Ｒ、１０６Ｇ、１０６Ｂが形成されている。また、カラーフィルタ１０６Ｒ、１０６Ｇ、１０６Ｂどうしの間には、ブラックマスク１０７が形成されている。さらに、これらカラーフィルタ１０６Ｒ、１０６Ｇ、１０６ＢおよびブラックマスクＢＭ１０７は、保護膜１０８で覆われている。保護膜１０８の対向内側面には、それぞれ平行に形成されてストライプ状をなす、複数の前液晶駆動電極１０９が形成され、これら前液晶駆動電極１０９および保護膜１０８を覆うように前配向膜１１０が形成されている。一方、後透明基板１０５の対向内側面には、上記した前液晶駆動電極１０９と交差する方向に、それぞれ平行に形成された複数の後液晶駆動電極１１１が配置されている。なお、前液晶駆動電極１０９と後液晶駆動電極１１１とが交差する領域は、上記した各カラーフィルタ１０６Ｒ、１０６Ｇ、１０６Ｂと対応するように設定されている。また、後透明基板１０５および後液晶駆動電極１１１とは、後配向膜１１２で覆われている。そして、前透明基板１０４と後透明基板１０５とが、それぞれの配向膜１１０、１１２が対向するように、図示しないシール材を介して貼り合わされ、両配向膜１１０、１１２およびシール材で形成される間隙に液晶１１３が封入されている。さらに、前透明基板１０４の対向外側面（前面）には前偏光板１１４が配置され、後透明基板１０５の対向外側面（後面）には、後偏光板１１５が配置されている。このような構成の液晶表示パネル１０２の後方に、バックライトシステム１０３が配置されている。このバックライトシステム１０３は、冷陰極管１１６、導光板１１７、反射板、拡散板などから構成されている。

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【０００３】このような構成の従来の液晶表示装置においては、バックライトシステム１０３からの光が液晶表示パネル１０２の液晶の変調された状態に応じて、透過したり遮断されたりすることで液晶表示が可能となる。また、各画素部分では、それぞれのカラーフィルタ１０６Ｒ、１０６Ｇ、１０６Ｂの作用に応じて分光された光が出射されるため、カラー表示が可能となる。

【０００４】

【発明が解決しようとする課題】しかしながら、上記した従来の液晶表示装置では、バックライトシステム１０３によって均一な面発光を得ることが困難であった。この原因は、バックライトシステム１０３の光源である冷陰極管１１６が、直線状のものやＵ字状のものであるため、この光源からの光を、導光板１１７の導波作用、反射板の反射作用、拡散板の散乱作用などを用いて、効率的でかつ均一な面発光を行うパネルにすることが困難であるからである。

【０００５】このようなバックライトシステムの問題点に対する方策として、面発光パネルである（分散型）無機ＥＬ（エレクトロルミネッセンス）パネルをバックライトシステムに用いる検討が行われている。しかし、無機ＥＬパネルは、十分な輝度が得られず、しかも発光寿命が短いという問題点がある。特に、無機ＥＬパネルでは、白色発光が得られにくく、もし得られたとしても発光効率が低いという問題点がある。このため、無機ＥＬパネルをバックライトとして実用的に用いることは困難であると考えられている。

【０００６】また、最近では、面発光パネルとして無機ＥＬ素子と比べ小さい印加電圧で高輝度に発光する有機ＥＬパネルの利用も検討されている。しかし、有機ＥＬパネルを用いても、カラーディスプレイのバックライトとして要望されている白色光を素子レベルで高発光効率で実現することは原理的にも難しいと考えられている。すなわち、有機ＥＬパネルにおける有機発光層に蛍光色素などを分散させて白色光を得ようとすると、近接した分子間のエネルギー遷移や段階的な失活による熱的損失により効率よく白色光を発生させることが困難となる。

【０００７】この発明が解決しようとする一の課題は、白色発光の面内均一性が高く、しかも高効率な発光を行うバックライトシステムを備えて、良好なカラー表示を

行うことのできる液晶表示装置を得るにはどのような手段を講じればよいかという点にある。また、この発明が解決しようとする他の課題は、高発光効率のカラー表示を可能にし、かつ消費電力を減少させることのできる液晶表示装置を得るには、どのような手段を講じればよいかという点にある。

【０００８】

【課題を解決するための手段】請求項１記載の発明は、液晶表示装置において、液晶表示パネルの後方に、前記液晶表示パネルの表示領域と対応して面発光を行う有機ＥＬ素子を備えるとともに、前記液晶表示パネルと前記有機ＥＬ素子との間に、該有機ＥＬ素子で発生される光の波長域を吸収して、それぞれ、互いに異なる波長域の光を発生する、複数のフォトルミネッセンス手段が配置されたことを特徴としている。

【０００９】請求項１記載の発明では、有機ＥＬ素子で発生された光がフォトルミネッセンス手段で吸収され、それぞれのフォトルミネッセンス手段では特有の波長域の光を発生する。これら複数のフォトルミネッセンス手段で発生した光は、液晶表示パネルに入射して表示用光となる。このような構成とすることにより、有機ＥＬ素子の面内で、同一の色の光が均一に発生し、この光を吸収したフォトルミネッセンス手段がそれぞれ異なる波長域の光を発生させるため、液晶表示パネル側でのカラー表示を行うことが可能となる。また、フォトルミネッセンス手段を用いることにより、有機ＥＬ素子で発生した光を用いてエネルギー効率のよい発光を行うことが可能となり、表示輝度の高い液晶表示を可能にする。

【００１０】

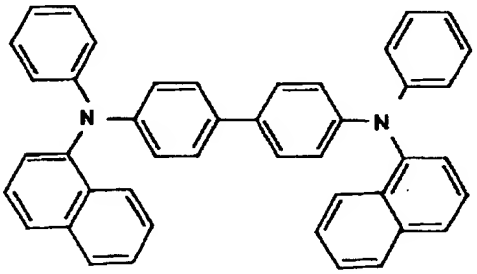
【発明の実施の形態】以下、この発明に係る液晶表示装置の詳細を図面に示す各実施形態に基づいて説明する。（実施形態１）図１は、この発明に係る液晶表示装置の実施形態１を示す断面図である。図中、１１は液晶表示装置である。この液晶表示装置１１は、同図に示すように、有機ＥＬ面発光パネル１２と液晶表示パネル１３とから構成されている。

【００１１】まず、有機ＥＬ面発光パネル１２の構成について説明する。有機ＥＬ面発光パネル１２は、図１に示すように、ガラス或いは合成樹脂でなる透明ＥＬ基板１４の後方（図中下方）の面（以下、後面という）側に液晶表示パネル１３の表示領域と対応する発光領域を有＊する有機ＥＬ素子１５が形成され、透明ＥＬ基板１４の前方（図中上方）の面（以下、前面という）側にフォトルミネッセンス（以下、ＰＬという）アレイとしての白色光合成層１６が有機ＥＬ素子１５の発光領域と対応するように形成されている。

【００１２】有機ＥＬ素子１５は、同図に示すように、透明ＥＬ基板１４の後面に、順次、アノード電極１７、有機ＥＬ層１８、カソード電極１９が積層されてなる。アノード電極１７は、透明な、例えばＩＴＯ（indium tin oxide）で、液晶表示パネル１３の表示領域と対応するように形成されている。有機ＥＬ層１８は、アノード電極１７側から順に、例えば、Ｎ,Ｎ′－ジ（α－ナフチル）－Ｎ,Ｎ′－ジフェニル－1,1′－ビフェニル－4,4′－ジアミン（以下、α－ＮＰＤという）からなる正孔輸送層と、4,4′－ビス（2,2′－ジフェニルビニレン）ビフェニル（以下、ＤＰＶＢｉという）が９６ｗｔ％と4,4′－ビス（２－カルバゾールビニレン）ビフェニル（以下、ＢＣｚＶＢｉという）が４ｗｔ％とからなる発光層と、トリス（８－ヒドロキシキノリン）アルミニウム錯体（以下、Ａｌｑ３という）からなる電子輸送層と、が積層されて構成されている。このような材料層により形成された有機ＥＬ層１８は、電界が印加されると青色光を発生する。この有機ＥＬ層１８の発光領域は、液晶表示パネル１３の表示領域と対応するように設定されている。以下に、α－ＮＰＤ、ＤＰＶＢｉ、ＢＣｚＶＢｉ、Ａｌｑ３の構造式を示す。

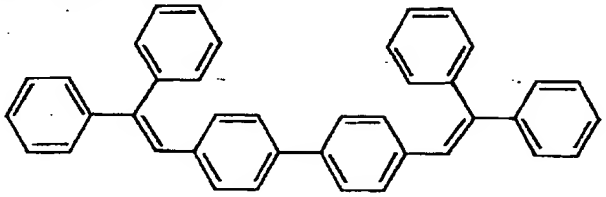
【００１３】

【化１】



α－ＮＰＤ

【化２】



ＤＰＶＢｉ

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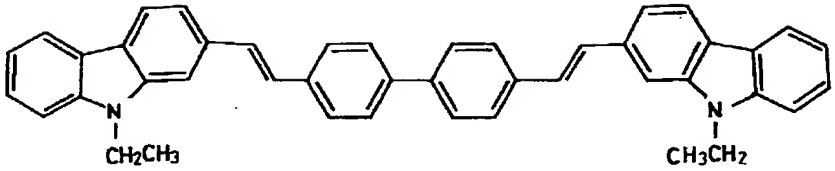
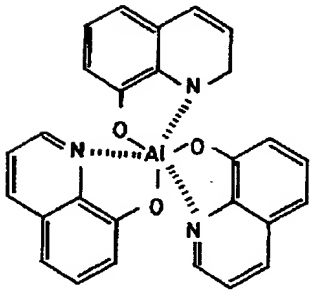
【化３】



BCzVBi

【化４】



Alq3

【００１４】そして、有機ＥＬ層１８の後面に形成されるカソード電極１９は、有機ＥＬ層１８へキャリアを注入し易い性質をもつメタル材料、例えばＭｇＩｎ、ＡｌＬｉなどで形成されている。このカソード電極１９も、液晶表示パネル１３の表示領域と対応するように形成されている。なお、図示はしないが、有機ＥＬ素子１５全面に水、酸素から遮蔽する保護膜が形成されている。

【００１５】次に、透明ＥＬ基板１４の前面側に形成される白色光合成層１６の構成について説明する。この白色光合成層１６は、青色の波長域の光を吸収して新たに赤色の波長域の光を発生する青・赤ＰＬ部１６Ｒと、青色の波長域の光を吸収して新たに緑色の波長域の光を発生する青・緑ＰＬ部１６Ｇと、青色の波長域の光を吸収して青色の波長色の光を発生する青・青ＰＬ部１６Ｂと、を所定の配列で互いに隣接するように配置したものであり、それぞれのＰＬ部の占有面積は液晶表示パネルの１画素の面積に比較して十分に微細（好ましくは、１画素面積の３分の１以下の面積）となるように設定されている。なお、これらＰＬ部を構成する材料としては、周知のフォトルミネッセンス材料を適用することができる。

【００１６】以上、有機ＥＬ面発光パネル１２の構成について説明したが、次に液晶表示パネル１３について説明する。なお、本実施形態では、液晶表示パネル１３として単純マトリクス駆動方式を用いる構成のものが適用されている。

【００１７】以下、本実施形態の液晶表示パネル１３の具体的な構成について説明する。本実施形態の液晶表示＊パネル１３は、前透明基板２０と後透明基板２１とを有している。前透明基板２０の対向内側面には、所定の配列でＲ、Ｇ、Ｂのカラーフィルタ２２Ｒ、２２Ｇ、２２Ｂが形成されている。また、カラーフィルタ２２Ｒ、２２Ｇ、２２Ｂどうしの間には、ブラックマスク２３が形成されている。さらに、これらカラーフィルタ２２Ｒ、２２Ｇ、２２Ｂおよびブラックマスク２３は、保護膜２４で覆われている。保護膜２４の対向内側面には、それぞれ平行に形成されてストライプ状をなす、複数の前液晶駆動電極２５が形成され、これら前液晶駆動電極２５を覆うように前配向膜２６が形成されている。一方、後透明基板２１の対向内側面には、上記した前液晶駆動電極２５と交差する方向に、それぞれ平行に形成された複数の後液晶駆動電極２７が配置されている。なお、前液晶駆動電極２５と後液晶駆動電極２７とが交差する領域（画素領域）は、上記した各カラーフィルタ２２Ｒ、２２Ｇ、２２Ｂと対応するように設定されている。また、後透明基板２１および後液晶駆動電極２７とは、後配向膜２８で覆われている。そして、前透明基板２０と後透明基板２１とが、それぞれの配向膜２６、２８が対向するように、図示しないシール材を介して貼り合わされ、両配向膜２６、２８およびシール材で形成される間隙に液晶２９が封入されている。さらに、前透明基板２０の対向外側面（前面）には前偏光板３０が配置され、後透明基板２１の対向外側面（後面）には、後偏光板３１が配置されている。

【００１８】次に、このような構成の液晶表示装置１１の作用・動作について説明する。液晶表示パネル１３で表示を行う場合、前液晶駆動電極２５と後液晶駆動電極２７とを線順次駆動することにより液晶２９に電界が印加され、電界の強度に応じて液晶２９が所定の配向になるように駆動される。この液晶２９の配向状態に応じて有機ＥＬ面発光パネル１２から出射された光が画素部を透過したり遮断されたりすることにより、表示が可能となる。このとき、液晶表示パネル１３の各画素部は、それぞれカラーフィルタ２２Ｒ、２２Ｇ、２２Ｂを備えているため、それぞれのカラーフィルタを透過した光はカラーフィルタの分光作用によってそれぞれＲ、Ｇ、Ｂの色の光を出射する。

【００１９】ところで、本実施形態では、有機ＥＬ素子

１５においてアノード電極１７とカソード電極１９との間に電界を印加すると有機ＥＬ層１８からは青色光が発生する。この青色光は、カソード電極１９が光反射性のメタル材料であるため、透明ＥＬ基板１４を透過して白色光合成層１６に入射する。このとき、白色光合成層１６においては、青・赤ＰＬ部１６Ｒで、有機ＥＬ素子１５からの青色の波長域の光を吸収して新たに赤色の波長域の光を発生する。また、青・緑ＰＬ部１６Ｇでは、青色の波長域の光を吸収して新たに緑色の波長域の光を発生する。さらに、青・青ＰＬ部１６Ｂでは、青色の波長域の光を吸収してより長波長の青色の波長色の光を発生する。また、これらＰＬ部１６Ｒ、１６Ｇ、１６Ｂは、上記したように、それぞれ、液晶表示パネルの１画素の面積に比較して十分に微細になるように設定されており、かつ所定の配列で互いに隣接するように配置されているため、それぞれのＰＬ部前方へは微細なＲ、Ｇ、Ｂのビーム光が発生する。これら多数のビーム光は、輻射的に拡散するため加法混色により白色光となる。そして、上記した液晶表示パネル１３の各画素部では、この白色光を液晶２９の配向状態に応じて透過または遮断する。白色光が画素部を透過する場合は、そのカラーフィルタにより分光され、所望の色の表示光を得ることができる。このような作用により、本実施形態の液晶表示装置１１ではカラー表示が可能となる。

【００２０】一般にフォトルミネッセンス材料は励起光の波長域に対し励起エネルギーとなる吸収光の波長域が近い程効率が良いが、特に、本実施形態では、白色光合成層１６を構成する各ＰＬ部において、可視光のうちで最も短波長域側の光である青色光を吸収してより長波長域の所定の波長域の光を発生させる作用を有するので可視光のフォトルミネッセンス効率が極めて高いため、エネルギー損失を低く抑えることができる。このため、有機ＥＬ素子１５からの発光を最大限に有効利用することができる。また、有機ＥＬ面発光パネル１２においては、白色光合成層１６の作用により、白色発光の面内均一性を高くすることができる。さらに、有機ＥＬ面発光パネル１２は、もともと発光効率の高い青色光を発生する有機ＥＬ素子１５を備えた構成であり、この青色光を起源として、白色光合成層１６で効率よく新たな光を発生させることができるため、表示光の輝度を高くすることができ、コントラストの良好な表示を行うことができる。また、本実施形態では、面発光を行う有機ＥＬ素子１５を用いるため、バックライトシステムを薄型化できるという利点を有する。さらにまた、有機ＥＬ素子１５は、低電圧直流駆動であるため、冷陰極管や無機ＥＬ素子のような高電圧交流駆動する素子に比較して輝度の連続的な可変が容易であり、仕様環境に応じて所望の輝度を設定できるという利点がある。

【００２１】（実施形態２）図２は本発明に係る液晶表示装置の実施形態２を示す断面図、図２は有機ＥＬ面発光パネル１２の拡大断面図である。本実施形態の液晶表示装置１１は、図２に示すように有機ＥＬ面発光パネル１２において白色光合成層１６の前面にフィルタアレイ３２を配置した構成である。なお、本実施形態における他の構成は、上記した実施形態１の構成と同様である。

【００２２】フィルタアレイ３２は、図２および図３に示すように、白色光合成層１６の青・赤ＰＬ部１６Ｒに対応する赤フィルタ部３２Ｒと、青・緑ＰＬ部１６Ｇに対応する緑フィルタ部３２Ｇと、青・青ＰＬ部１６Ｂに対応する青フィルタ部３２Ｂと、が互いに隣接するように配置されたものである。

【００２３】図３に示すように、アノード電極１７とカソード電極１９との間に電界が印加されると、有機ＥＬ層１８から青色光Ｂが面発光される。この青色光Ｂは青・赤ＰＬ部１６Ｒ、青・緑ＰＬ部１６Ｇ、青・青ＰＬ部１６Ｂに入射してそれぞれ赤色光Ｒ、緑色光Ｇ、青色光Ｂ′となる。これら各ＰＬ部から出射された光は、フィルタアレイ３２の各部で色純度が高められる。このため、フィルタアレイ３２から各光により加法混色されて純度の高い白色光を発生させることができる。特に、本実施形態においては、良好な白色を実現できるため、フィルタアレイ３２の各部の光透過率を調整することで各色の強度バランスを設定することができる。また、青・赤ＰＬ部１６Ｒと青・緑ＰＬ部１６Ｇと青・青ＰＬ部１６Ｂの上に、それぞれ赤フィルタ部３２Ｒ、緑フィルタ部３２Ｇ、青フィルタ部３２Ｂが配置されているため、有機ＥＬ素子１５で発生した青色光Ｂが青・赤ＰＬ部１６Ｒ、青・緑ＰＬ部１６Ｇおよび青・青ＰＬ部１６Ｂを抜け出た場合に、その青色光Ｂが液晶表示パネル１３側に入射するのを防止することができる。このため、有機ＥＬ素子１５の発光出力を高くしても、青色光Ｂが抜け出ることがなく、輝度の高い良好な液晶表示を可能にする。なお、本実施形態においては、青・青ＰＬ部１６Ｂ上に青フィルタ部３２Ｂを配置したが、青フィルタ部３２Ｂを配置せずまたは透明部として、青色光がそのまま液晶表示パネル１３側へ出射されるようにしてもよい。

【００２４】（実施形態３）図４は、本発明に係る液晶表示装置の実施形態３を示す断面図である。本実施形態では、有機ＥＬ面発光パネル１２において白色光合成層１６の前面に光透過性を有しかつ光拡散性を有する拡散板３３を配置している。なお、本実施形態における他の構成は、上記した実施形態１と同様である。本実施形態においては、白色光合成層１６の各ＰＬ部で発生する光をより拡散させることで、均一な面発光にするとともに加法混色された白色光の色純度を高めることができ、表示性能を向上させることができる。

【００２５】（実施形態４）図５は、本発明に係る液晶表示装置の実施形態４を示す断面図である。本実施形態では、有機ＥＬ面発光パネル１２において白色光合成層１６の前面に、マイクロレンズアレイ３４を配置してい

る。なお、本実施形態における他の構成は、上記した実施形態１と同様である。本実施形態においては、白色光合成層１６の各ＰＬ部で発生した光をマイクロレンズアレイ３４で集光した後拡散させる作用があるため、各ＰＬ部から出射された光を混合する効果が高くなり、この結果、均一な面発光にするとともに加法混色された白色光の色純度を高めることがでる。このため、本実施形態においても、液晶表示装置１１の表示性能を向上させることができる。

【００２６】（実施形態５）図６は、本発明に係る液晶表示装置の実施形態５を示す断面図である。本実施形態における有機ＥＬ面発光パネル１２は、透明ＥＬ基板１４の後面側の構成が上記した実施形態１と同様であり、有機ＥＬ素子１５が形成されている。透明ＥＬ基板１４の前面には、液晶表示パネル１３の各画素部（前液晶駆動電極と後液晶駆動電極とが交差する領域）に対応するように、それぞれ、画素面積と略同一の面積を有するＰＬ層が配置・形成されている。ＰＬ層としては、図６に示すように、青・赤ＰＬ層３５Ｒと青・緑ＰＬ層３５Ｇと青・青ＰＬ層３５Ｂとがある。これらのＰＬ層は、後記する液晶表示パネル１３の各画素と対応するように、所定の配列で形成されている。

【００２７】次に、本実施形態における液晶表示パネル１３の構成を説明する。本実施形態の液晶表示パネル１３は、カラーフィルタを備えていない。すなわち、前透明基板２０の後面に複数の前液晶駆動電極２５がストライプ状に形成されている。これら前液晶駆動電極２５どうしの間には、ブラックマスク２３が形成されている。そして、前液晶駆動電極２５とブラックマスク２３の後面（対向内側面）には、前配向膜２６が形成されている。なお、液晶表示パネル１３における他の構成は、上記した実施形態１と同様である。

【００２８】本実施形態の液晶表示装置１１における作用・動作について説明する。まず、有機ＥＬ素子１５のアノード電極１７とカソード電極１９との間に直流電圧或いはパルス波形電圧が印加されると有機ＥＬ層１８から青色光が発生する。この青色光は、それぞれ、青・赤ＰＬ層３５Ｒ、青・緑ＰＬ層３５Ｇ、青・青ＰＬ層３５Ｂで、赤色光と、緑色光と、青色光とを発生して出射する。この出射光は、液晶表示パネル１３に入射して各画素部の液晶２９の配向状態に応じて、液晶２９を透過または液晶２９で遮蔽される。透過した各色の光は、液晶２９の配向状態に応じて輝度調整が行われる。そして、液晶表示パネル１３で画素選択を行うことにより、カラー表示を自在に行うことが可能となる。

【００２９】本実施形態においては、カラー液晶表示パネル１３において、各画素毎に各画素の表示色に応じた色を発光するＰＬ層を設けているので、ブラックマスク２３で覆われる非表示領域を発光せずにすむとともにカラーフィルタを用いることなく多色表示を行うことができ、各表示色を含む白色を吸収、分光して多色表示する液晶表示装置に比べ、ＰＬ層の発光色の輝度に対し表示する光の輝度の割合が高く、光の透過効率を大幅に向上することができる。また、有機ＥＬ面発光パネル１２が高効率な青色発光を行う有機ＥＬ素子１５を用いるとともに、フォトルミネッセンス効率の高いＰＬ層を用いてＲ、Ｇ、Ｂの光を実現しているため、液晶表示装置１１全体としての、光利用効率を大幅に高めることができる。また、このように光利用効率を高めたことにより、消費電力を削減することができるという利点がある。

【００３０】（実施形態６）図７は、本発明に係る液晶表示装置の実施形態６を示す断面図である。本実施形態においては、上記した実施形態５の有機ＥＬ面発光パネル１３の各ＰＬ層３５Ｒ、３５Ｇ、３５Ｂの前面に、それぞれのＰＬ層で発生して出射される光の色純度を高めるために、それぞれ、赤フィルタ層３６Ｒ、緑フィルタ層３６Ｇ、青フィルタ層３６Ｂが対応するように配置された構成である。なお、本実施形態における他の構成は、上記した実施形態５を同様である。

【００３１】本実施形態においては、有機ＥＬ素子１５で発生した青色光が、青・赤ＰＬ層３５Ｒ、青・緑ＰＬ層３５Ｇ、青・青ＰＬ層３５Ｂを抜け出た場合或いは各ＰＬ層３５Ｒ，３５Ｇ，３５Ｂの発光波長域がブロードの場合に、これらＰＬ層の上に配置されたフィルタ層が変調により出射された光以外の成分を吸収する作用あるいは鋭敏なピークの波長域の光を出射する作用を有するため、液晶表示パネル１３の各画素部に入射する光の色純度を高めることができるように設定されている。また、有機ＥＬ素子１５の発光強度を高く設定しても、青色光の抜け出しを防止できるため、高輝度の表示を行うことが可能となる。

【００３２】（実施形態７）図８は、本発明に係る液晶表示装置の実施形態７を示す断面図である。本実施形態においては、上記した実施形態５の液晶表示装置１１の各後液晶駆動電極２７に接続されたａ－Ｓｉからなる半導体層を有する薄膜トランジスタ４２と、有機ＥＬ面発光パネル１３の各ＰＬ層３５Ｒ、３５Ｇ、３５Ｂの間に、ＰＬ層の発光を薄膜トランジスタ４２から遮光するブラックマスク４１を設けた構成である。なお、本実施形態における他の構成は、上記した実施形態５を同様である。実施形態７では、外光はブラックマスク２３で遮光でき、有機ＥＬ面発光パネル１２の発光はブラックマスク４１が遮光するので、半導体層へのキャリアを生成する励起光の入射を抑制でき、薄膜トランジスタ４２の誤作動を防止することができる。

【００３３】以上、実施形態１～実施形態７について説明したが、本発明はこれらに限定されるものではなく、構成の要旨に付随する各種の変更が可能である。例えば、上記各実施形態においては、青色光を発生させる有機ＥＬ層１８としてα－ＮＰＤからなる正孔輸送層と、

ＤＰＶＢｉが９６ｗｔ％とＢＣｚＶＢｉが４ｗｔ％とからなる発光層と、Ａｌｑ３からなる電子輸送層と、が積層された構成であるが、実質的に青色光を発生させる有機ＥＬ材料層であればこれに限定されるものではない。また、上記各実施形態においては、青色光を青・青ＰＬ部１６Ｂや青・青ＰＬ層３５Ｂを用いたが、有機ＥＬ層１８から出射される青色光がそのまま表示光として波長域が適切なものであれば、青・青ＰＬ部１６Ｂや青・青ＰＬ層３５Ｂを省略しても勿論よい。

【００３４】また、上記した各実施形態においては、透明ＥＬ基板１４の前面側に各ＰＬ部を配置し、後面側に有機ＥＬ素子１５を形成したが、透明ＥＬ基板１４の上に有機ＥＬ素子１５を形成し、この有機ＥＬ素子１５の上に各ＰＬ部を配置する構成とすることも勿論可能である。また、白色光合成層１６上に保護膜を形成してもよい。

【００３５】さらに、上記した各実施形態においては、有機ＥＬ層１８が青色光を発生させる構成としたが、他の波長域の光、例えば紫外光、青紫光などを起源光して発生させる材料で構成してもよい。この場合には、ＰＬ部やＰＬ層がこれらの起源光を例えばＲ、Ｇ、Ｂの光に変調するようにするように設定すればよい。

【００３６】またさらに、上記した各実施形態においては、液晶表示パネル１３が単純マトリクス駆動による構成としたが、画素電極やスイッチング素子としての薄膜トランジスタを備えたアクティブ駆動方式の構成としても勿論よい。また、液晶表示モードも適宜変更することが勿論可能であり、その液晶表示モードに応じて偏光板の有無も適宜変更されるものである。特にＰＤＬＣのような液晶モードでは、偏光板無しに光シャッタとして機能するので、輝度の高い表示を行うことができる。さらに、上記した各実施形態では、ＰＬ部やＰＬ層を有機ＥＬ面発光パネル１２側に設けたが、これら液晶表示パネル１３側に設ける構成としても勿論よい。上記液晶表示装置は、明時では反射型として外光をカソード電極１９で反射して表示し、暗時では透過型として有機ＥＬ面発光パネル１２を発光させ表示するように選択を可能にしても良い。

【００３７】

【発明の効果】以上の説明から明らかなように、この発明によれば、白色発光の面内均一性が高く、しかも高効率な発光を行うバックライトシステムを備えて、良好なカラー表示を行うことのできる液晶表示装置を実現するという効果を奏する。また、この発明によりば、高発光効率のカラー表示を可能にし、かつ消費電力を減少させることのできる液晶表示装置を実現するという効果を奏する。

【図面の簡単な説明】

【図１】本発明に係る液晶表示装置の実施形態１を示す断面図。

【図２】本発明に係る液晶表示装置の実施形態２を示す断面図。

【図３】実施形態２の拡大断面図。

【図４】本発明に係る液晶表示装置の実施形態３を示す断面図。

【図５】本発明に係る液晶表示装置の実施形態４を示す断面図。

【図６】本発明に係る液晶表示装置の実施形態５を示す断面図。

【図７】本発明に係る液晶表示装置の実施形態６を示す断面図。

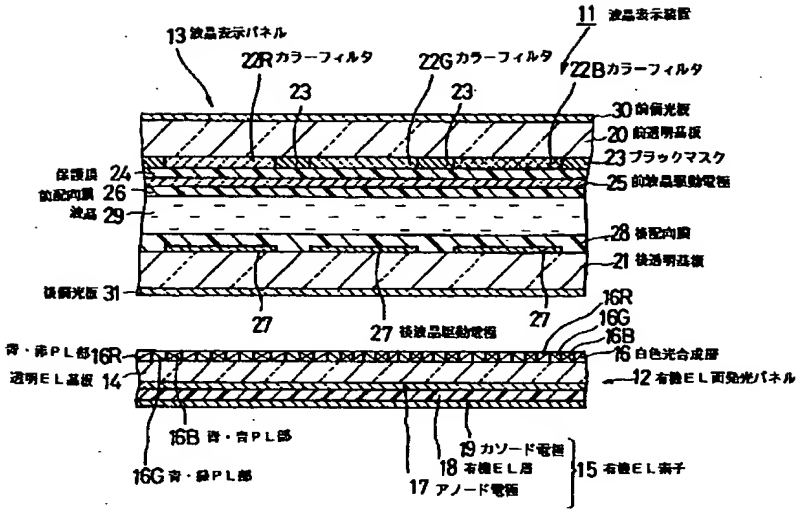
【図８】本発明に係る液晶表示装置の実施形態７を示す断面図。

【図９】従来の液晶表示装置を示す断面図。

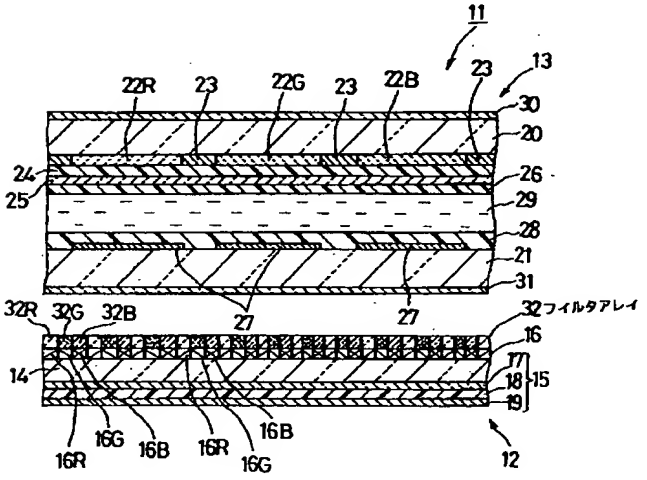
【符号の説明】

１１　液晶表示装置
１２　有機ＥＬ面発光パネル
１３　液晶表示パネル
１５　有機ＥＬ素子
１６　白色光合成層
１６Ｒ　青・赤ＰＬ部
１６Ｇ　青・緑ＰＬ部
１６Ｂ　青・青ＰＬ部
３２　フィルタアレイ
３３　拡散板
３４　マイクロレンズアレイ
３５Ｒ　青・赤ＰＬ層
３５Ｇ　青・緑ＰＬ層
３５Ｂ　青・青ＰＬ層

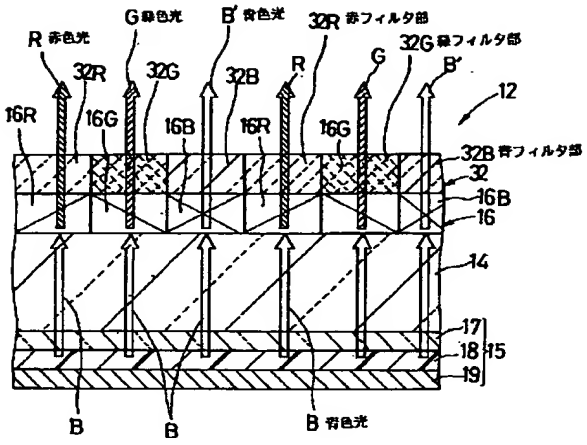
【図１】


11 液晶表示装置
13 液晶表示パネル
22R カラーフィルタ
22G カラーフィルタ
22B カラーフィルタ
23
30 前偏光板
20 前透明基板
23 ブラックマスク
保護膜 24
前配向膜 26
25 前液晶駆動電極
液晶 29
28 後配向膜
21 後透明基板
後偏光板 31
27
27 後液晶駆動電極
16R
16G
16B
16 白色光合成層
青・赤ＰＬ部 16R
透明ＥＬ基板 14
12 有機ＥＬ面発光パネル
16B 青・青ＰＬ部
16G 青・緑ＰＬ部
19 カソード電極
18 有機ＥＬ層
17 アノード電極
15 有機ＥＬ素子

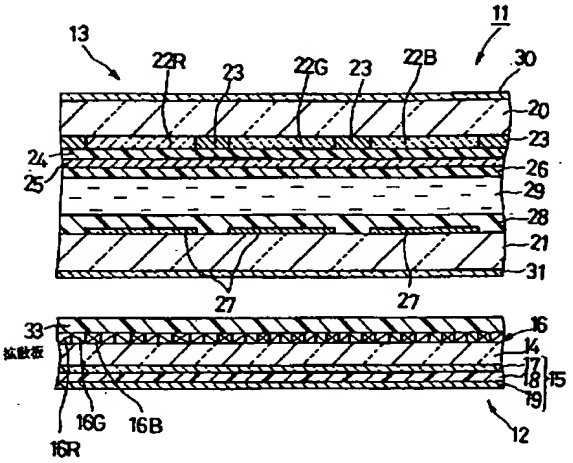
【図２】


11
13
22R
23
22G
23
22B
23
30
20
24
25
26
29
28
21
31
27
27
32R
32G
32B
32 フィルタアレイ
16
14
17
18
15
19
16R
16G
16B
16R
16B
16G
12

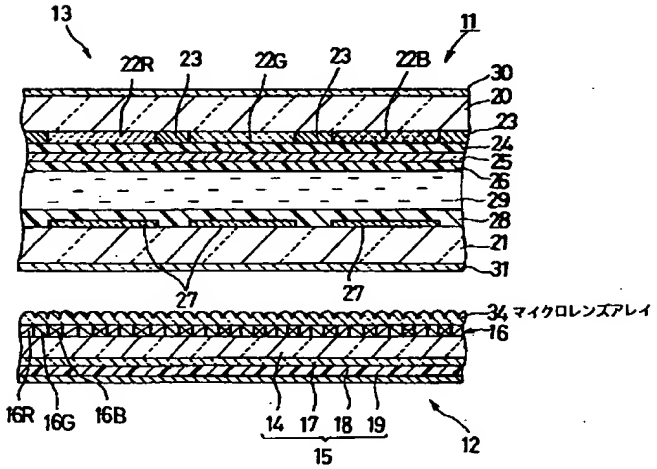
【図3】


R 赤色光
G 緑色光
B' 青色光
32R 赤フィルタ部
32G 緑フィルタ部
32B 青フィルタ部
32R
32G
32B
R
G
B'
12
16R
16G
16B
16R
16G
32
16B
16
14
17
18
15
19
B
B
B 青色光

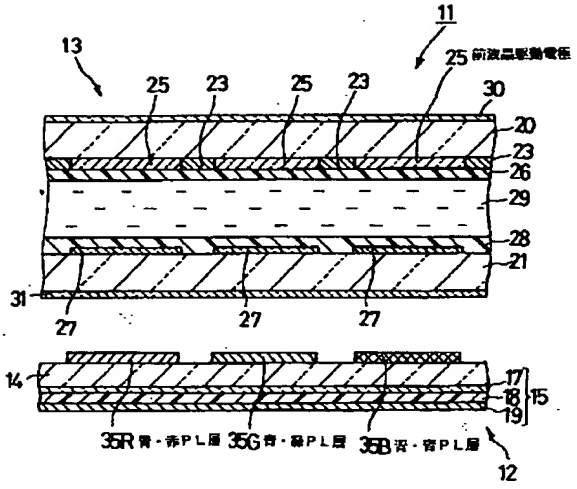
【図4】


11
13
22R
23
22G
23
22B
30
20
23
24
25
26
29
28
21
31
27
27
33
拡散板
16
14
17
18
15
19
16G
16B
16R
12

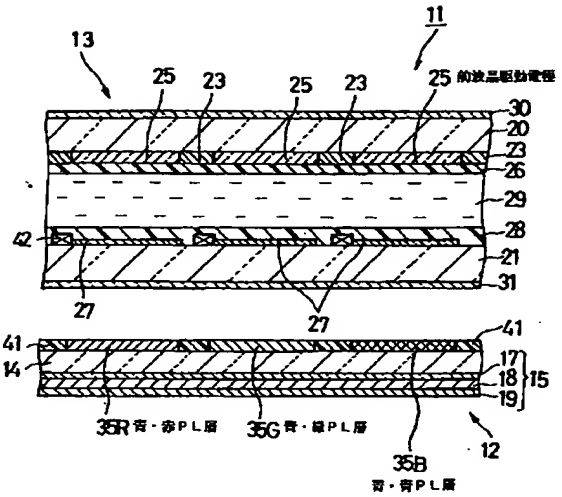
【図5】


13
11
22R
23
22G
23
22B
30
20
23
24
25
26
29
28
21
31
27
27
34 マイクロレンズアレイ
16
16R
16G
16B
14
17
18
19
15
12

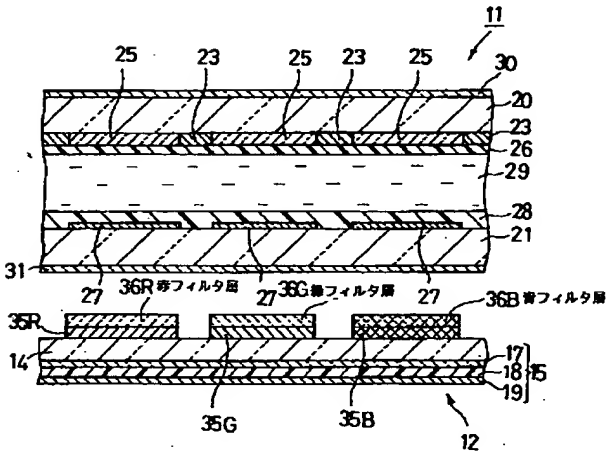
【図6】


11
13
25
23
25
23
25 前液晶駆動電極
30
20
23
26
29
28
21
31
27
27
27
14
17
18
19
15
35R 青・赤PL層
35G 青・緑PL層
35B 青・青PL層
12

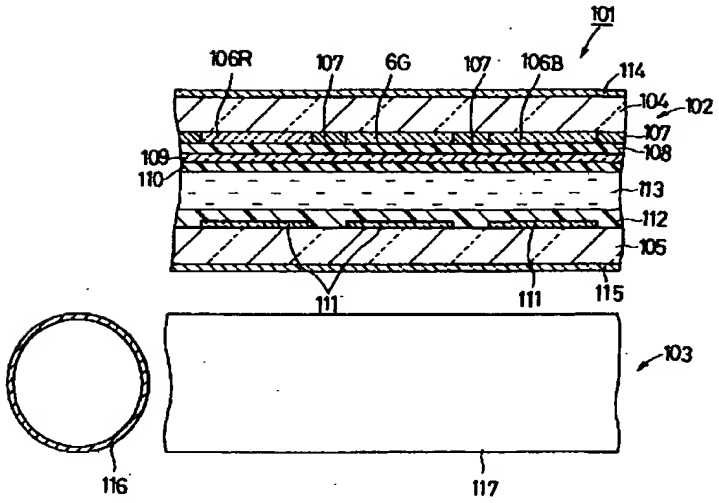
【図8】


11
13
25
23
25
23
25 前液晶駆動電極
30
20
23
26
29
42
28
21
31
27
27
41
14
17
18
19
15
35R 青・赤PL層
35G 青・緑PL層
35B
青・青PL層
12

【図7】


11
25
23
25
23
25
30
20
23
26
29
28
21
31
27
36R 赤フィルタ層
27
36G 緑フィルタ層
27
36B 青フィルタ層
35R
14
17
18
19
15
35G
35B
12

【図9】


101
106R
107
6G
107
106B
114
104
102
107
108
109
110
113
112
105
111
111
115
103
116
117